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Ambulatory Outcome in Children with Developmental Delay

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Objective: To identify early predictors of walking in children with motor developmental delay.

Setting: Child development unit, pediatric department, Salmaniya Medical Complex.

Design: Retrospective study.

Method: Patients seen from January 2006 to June 2006 were included in the study and their characteristics were reviewed.

We used 10-criteria practical motor assessment scheme to chart the acquisition, from the prone position to walking, according to a standardized procedure. Data were collected using case notes and through direct assessment.

Result: Seventy-two patients fitting our inclusion criteria presented over the study period, 37 were boys and 35 were girls. We found that ambulatory status was related to the rate of acquisition of the motor skills. Thirty-seven (51%) of the 72 children managed to walk, 17 (23%) independently and 20 (28%) with assistance; 35 (49%) did not manage to walk. All of the independent walkers were able to roll over by 18 months and sit by 24 months of age. Ambulatory status was related to early acquisition of specific motor and to developmental quotient: None of the patients who walked independently had cognitive developmental delay.

Conclusion: The findings of this study showed that the ability to achieve walking can be predicted before the age of two years from two motor variables only: rolling over and sitting. It also showed that there is positive correlation between the ability to achieve walking and the cognitive development.

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Motor development is the process of change in motor behavior that is related to the age of individual[1]. Pediatric motor development takes place in an orderly and sequential manner; developmental delay refers to a performance significantly below average in a given area of skill. A developmental quotient below 70 constitutes developmental delay[2].

Parents and pediatricians need information on the ambulatory outcome of children with motor developmental delay. Accurate prediction of ambulatory status is central to early intervention and appropriate plan of management of children with motor developmental delay.

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Most of the previous studies on ambulatory outcome of children with developmental delay were retrospective. Furthermore, few studies have addressed the relationship between ambulatory status and the cognitive development. Susceptibility of children to environmental influences is another factor that contributes to the difficulty of predicting the ambulatory outcome[3-5]. The nature of environmental influences is not well understood[6]. There are no previous studies in Bahrain that addressed the early predictors of walking.

Moreover, with the new advances in neonatal care world wide there is increase in the survival rate of premature infants and hence of the cerebral palsy, which is the most common cause of motor developmental delay[7]. In addition, there has been an increase in health awareness in Bahrain which has resulted in the early referral of children with developmental delays to the child developmental unit. Therefore, the purpose of this study is to find the early predictors of ambulation.

The aim of this study is to find early prediction of ambulation in children with developmental delay.

Method

The study was performed from January 2006 to June 2006. Inclusion criteria were (1) clinical diagnosis of motor developmental delay with or without cognitive delay (2) patient age 3 years or more (3) new and follow-up cases were included.

Seventy-two patients fitted the inclusion criteria presented over the study period.

Data were collected using case notes and through direct assessment.

We used 10-item practical motor assessment scheme (Table 1) to chart the acquisition, from the prone position to walking. The cognitive development was assessed according to the general quotient of the Griffiths Mental Developmental Scale, excluding the locomotor and fine motor sub-scales.

Table 1: Practical Motor assessment scheme

Motor skill	Age of achievement
1. Prone lifts head	
2. Prone lifts head & chest	
3. Rolls	
4. Sits with support	
5. Sits alone	
6. Crawls	
7. Pulls self to stand and stands holding on furniture	
8. Can walk when led	
9. Stands alone	
10. Walks alone	

All the children underwent physiotherapy according to a neurodevelopmental approach.

RESULT

Seventy-two patients fitted the inclusion criteria presented over the study period, 37 were boys and 35 were girls. The age range was between 3 and 8 years. Median age was 5 years and 6 months. Gestational age ranged from 28 to 38 weeks. The Median gestational age was 33 weeks.

The patients were divided into 3 subgroups. Walking independently, walking with support and not walking.

Thirty-seven patients managed to walk, 17 walked independently and 20 walked with support. Thirty-five patients did not achieve walking. Table 2 illustrates the different patient groups.

Table 2: Patient Groups

Patient Group	Number of patients	Percentage of total patients
Walking independently	17	23%
Walking with support	20	28%
Not walking	35	49%

Cognitive development was assessed (as Griffiths general quotient) in all of the 72 children, 31 (43%) had normal cognitive development, the general quotient was normal (greater than 85), in 20 children (28%) the general quotient was borderline (71 to 84), and in 21 (29%) the general quotient was below normal (less than 70).

In the walking independently group, 14 patients (82%) had normal Cognitive Development, 3 had borderline cognitive developmental delay and none of them had cognitive developmental delay (Figure 1 and Table 3).

Table 3: The number and the percentage of children sitting by 24 months of age

Patient group	Total number of patients	No. of children sitting by 24 months of age	Percentage of total
Walking independently	17	17	100%
Walking with support	20	13	65%
Not walking	35	none	0%

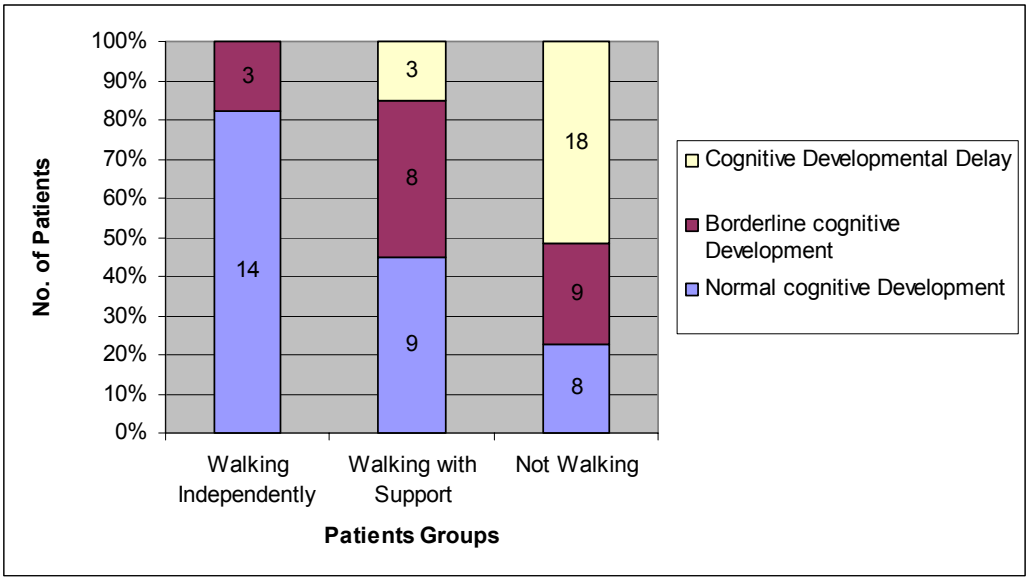

Figure 1: The cognitive development in the 3 outcome groups

In the walking with support group, 9 children (45%) had normal cognitive development, 8 (40%) had borderline developmental delay and 3 (15%) had cognitive delay.

In the not walking group, 8 children (23%) had normal cognitive development, 9 children (26%) had borderline cognitive developmental delay and 18 (51%) had cognitive developmental delay.

The age at walking, with or without support, was at 2 years in 18 patients (48.6 %), 3 years in 11 children (29.8 %) and 4 years in 8 children (21.6%). After 5 years of age, the rate of acquisition of the motor skills tends to plateau.

We found that children who could walk independently had rapid rate of achievement of early motor skills in the first 30 months.

Rolling was acquired by all the independent walkers by 18 months of age. Sitting and crawling were acquired by 24 and 30 months of age respectively in most of the independent walkers. The number of motor functions achieved tends to stabilize after 60 months of age. This trend was apparent in all cases.

Among the children who could not walk there was a uniform slow rate of an acquisition of early motor skills. Only 4 of them were able to roll over by 30 months and one of them was able to sit by 36 months of age. Table 3 and 4 illustrate the acquisition of sitting and crawling in the different patient groups respectively.

Table 4: The number and percentage of children crawling by 30 months of age

Patient group	Total number of patients	No. of children crawling by 30 months of age	Percentage of total
Walking independently	17	14	82%
Walking with support	20	9	45%
Not walking	35	none	0%

However, in children who could walk with assistance, the rate of acquisition of motor skills was variable. Hence, among the pre-locomotor skills, rolling was acquired by all independent walkers by 18 months, while the acquisition of sitting occurred by 24 months. Therefore, the acquisition of rolling by 18 months seems to be a good cut-off age to distinguish potential independent walkers from those who will not walk. As far as the sitting posture is concerned, a better cut-off age seems to be 24 months.

Ambulatory status was related to developmental quotient: None of the patients who walked independently had cognitive developmental delay (Figure 1 and Table 5).

Table 5: Relationship between walking and cognitive development

Patient group	Total No. of Patients	Normal Cognitive Development		Borderline Cognitive Development		Cognitive Developmental Delay	
		No.	%	No.	%	No.	%
Walking Independently	17	14	82	3	18	0	0
Walking with Support	20	9	45	8	40	3	15
Not Walking	35	8	23	9	26	18	51

DISCUSSION

It is important to be able to predict whether children with motor delay will walk or not in order to plan appropriate therapeutic and rehabilitation objectives and to inform the parents.

This is the first study in Bahrain that addresses the early predictors of walking and tries to answer the parent's concern whether their child will ever be to walk or not.

In this study, we found that children who managed to walk were characterized, as a group, by rapid and uniform achievement of early milestones before 30 months of age, while those who did not achieve walking were characterized by very slow acquisition of these skills between the ages of 18 and 30 months. This indicates that 30 months is critical for determining ambulatory potential in these children, and it is therefore important clinically for defining, within this age, the walking prognosis and consequently for planning therapeutic objectives.

Most studies of the practical assessment and predictive factors for walking had been retrospective and few studies have addressed the relationship between ambulatory status and cognitive development in developmental delay.

Previous studies have reported that the earlier the achievement of milestones, the better the prognosis for ambulation, either independently or with assistance[8,9].

Sales and Grant reported that primitive reflexes, postural reactions, gross motor skills, and the type of cerebral palsy seemed to be the main factors in predicting the achievement of ambulation[10].

It was reported in previous studies that the acquisition of specific motor skills at an early age is a predictive of independent walking. For example, acquiring competencies of head balance and rolling over before 18 months of age are important prognostic signs for walking[8,9,11].

Thus, competencies in up-righting sequences from the prone position and rolling are prerequisites for independent sitting and independent walking. If they are acquired before 18 months, they can be defined as early predictors of ambulation than sitting by 2 years of age. We also found a relationship between ambulatory status at age of 3 to 5 years and cognitive development that was in agreement with the findings of Watt et al in their prospective study[11].

It is suggested that by the age of 3 years, a sufficiently clear functional prognosis can be made and those who by the age of 3 years have yet to achieve locomotion patterns which require adequate trunk control, will need the early supply of adequate assistive devices to enable them to develop assisted motor independence, generally a powered wheelchair[12,13]. Several other reports suggest that the nature of the locomotor patterns achieved in the first months/years of life (e.g. crawling) and the age at which these are achieved, are crucial for the development or non-development of independent walking and play a very important role in defining prognosis[8,14-16].

The age of 3 years seems to be a turning point: those who did not achieve a locomotion pattern such as crawling, bunny-hopping, or shuffling, which requires adequate trunk control, by the age of 3 years have very little chance of developing a functional independent walking pattern, at least in the case of spastic syndromes[14,15].

Furthermore, the data from Bottos et al study show that the maintenance of independent walking is statistically associated with the age at which independent walking was achieved; those who reached independent walking by the age of 3 years showed a higher chance of maintaining a long-standing and efficient gait than those who did not achieve it by that age[14,17].

This study also indicated that ability to achieve walking can be predicted before the age of 2 years from two motor variables: rolling over and sitting.

However, the relationship between the ambulatory outcome and the cognitive development is more controversial.

We found relationship between ambulatory status and cognitive development in agreement with the findings of Watt et al[11]. The association between the severity of motor delay and the delay in cognitive development could be related to periventricular leukomalacia of cerebral palsy which is the most common cause of motor developmental delay. The development of motor, cognitive and visual skills is very closely related at an early age and the development of behavior reflects the complexity of all these interacting factors[18].

Bottos et al found that the achievement of locomotion and its maintenance in adulthood were statistically related to diagnosis and motor impairment ($p<0.01$), but were not related to intellectual level. Though Bottos et al found that there is a relationship between intellectual level and the achievement and maintenance of locomotion approached significance, only two in Bottos et al study of 15 participants with profound learning disability achieved independent walking versus 16 of 27 with normal/borderline intelligence. Only one of 16 with profound learning disability maintained independent walking at the time of the study versus 10 of 27 (37%) participants with normal/borderline intelligence[14].

CONCLUSION

The findings of this study showed that the ability to achieve walking can be predicted before the age of two years from two motor variables: rolling over and sitting. It also showed that there is positive correlation between the ability to achieve walking and the cognitive development.

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