DEVELOPMENTAL STUDY OF EARLY POSTURE CONTROL IN PRETERM AND FULLTERM INFANTS

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ABSTRACT - In a prospective study, 10 infants born between 32 to 36 weeks of gestation and 10 infants born at fullterm were observed on day 15, and in months 1, 2 and 3. The investigation showed that the development of early postural control takes place in a sequential way in preterm infants, similar to that of in fullterm infants. However, some movement components for the acquisition of motor abilities showed a different trend in the development of preterm infants when compared to fullterm infants: the onset for the acquisition of the extensor and flexor patterns was slower and the distribution of the load bearing was less mature.

KEY WORDS**:** early posture control, preterm and term infants, movement components, load bearing.

Estudo do desenvolvimento do controle postural precoce em crianças pré-termo e a termo

RESUMO - Em um estudo prospectivo 10 crianças nascidas com idade entre 32 e 36 semanas de gestação (corrigida a idade gestacional) e 10 crianças a termo foram observadas no 15º dia, 1, 2 e 3 meses de vida. Foi constatado que o desenvolvimento do controle postural precoce evolui de forma seqüencial em crianças pré-termo, semelhante ao das a termo. Entretanto, alguns componentes de movimentos, para aquisição das habilidades motoras, mostraram tendência diferenciada no desenvolvimento de crianças pré-termo, quando comparadas com as a termo: o início da aquisição do padrão extensor e flexor aconteceu de maneira mais lenta e a descarga de peso foi menos madura.

PALAVRAS-CHAVE: controle postural precoce, pré-termo e a termo, componentes de movimento, descarga de peso.

The assessment of motor development during the first three months of life in infants born at term, and mainly in those born at preterm, is still a challenge for physiotherapists. According to Campbell, pediatric therapists are looking for tests to evaluate the quality of movement, postural control and alignment, balance and coordination, and functional ability measures to provide information based on the evolution of infants with a slower movement development rate[1].

The team at Chailey Heritage Clinical Service, England, while investigating the motor behavior of normal children to the point they could sit independently, identified and described sequential levels of early postural control for lying in supine and prone positions and for sitting, creating the Chailey Levels of Abilities scale[2,3]. This instrument takes into account that the motor development depends on the child's behavioral state, the surrounding environment, biomechanics and the motor task itself. The same evaluation was carried out in children with cerebral palsy[4].

Taking into consideration that the use of this instrument of evaluation could meet the expectations of an evolutionary study of the motor development, a longitudinal follow up was carried out with a group of healthy preterm and fullterm infants, during their first three months of age.

METHOD

The study group consisted of ten preterm healthy infants, gestational age between 32 and 36 weeks (mean age 33 weeks 6 days) and 10 fullterm infants used as the control group, aged between 38 weeks 2 days and 41 weeks 1 day (mean age 39 weeks 4 days); all of them born at the Universidade Estadual de Londrina Hospital in Londrina, Paraná, Brazil. The gestational age was determined by either the Capurro method[5] or the New Ballard method[6] and corrected at 40 weeks for the preterm group.

Birth weight of the preterm infants varied from 1490g to 2280g (mean weight 1833.50g) and that of the fullterm from 2910g to 4040g (mean weight 3404g). One preterm infant was identified as small for its gestational age and three fullterm infants were classified as big. Out of 20 infants, 16 (80%) were considered adequate to their gestational age. None of the preterm infants required mechanical ventilation. Average length of stay in hospital was 21.9 days for the preterm and 2 days for the fullterm infants.

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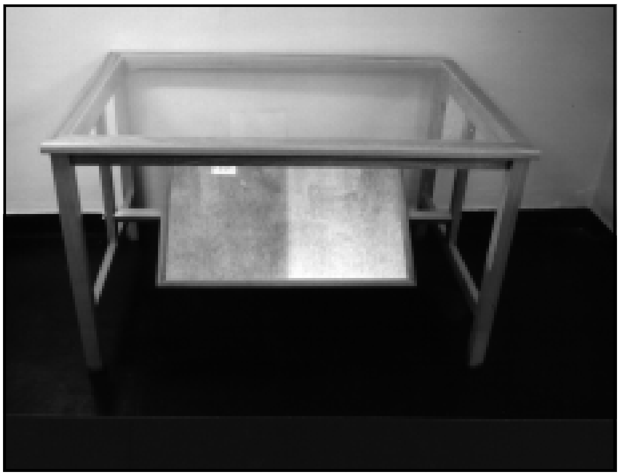

Fig 1. Acrylic top table with angled mirror below.

Infants with periventricular hemorrhage and leukomalacia, infections, genetic abnormalities and malformations were excluded from the study. All infants were submitted to the Neurological Developmental Assessment[7] in order to confirm whether their development was within normal limits.

The methodological foundation of this study comes from works by Pountney et al.[3] and Green et al.[4], following the Chailey Levels of Ability assessment. In this scale, the evolution of early postural control is shown through six levels of abilities for each one of the supine and prone positions, and seven levels for sitting. These levels are sets for the observation of spontaneous activities by the infant, focusing on changes in position and movements of the shoulder girdle and pelvis, head and limbs as well as their relation with changes in load bearing, ability to move within, into and out of position.

All infants were photographed and videorecorded at the research laboratory of the University Hospital Physiotherapy Department. A special table (Fig 1) was designed for the photographic sessions, following the Chailey Heritage model[3]. The table, with an acrylic top and a mirror angled at 45º shows the areas of body contact where the weight bearing occurs when the infant is on the table lying in supine and prone positions and sitting. For the recording session, a cushioned and sturdy platform was used and the infants were evaluated in the following positions: lying in prone and supine, pulled to sit and sitting. Room temperature ranged from 26º to 30º.

The most mature ability presented for each position (photos or videos) was considered and a grade was assigned to each of them. All the observations were made when the infants were at state 4 (alert and minimum motor activity) or state 5 (alert and considerable motor activity), according to Brazelton's parameters[8]. The first assessment was made at 15 days, following assessment at 1 month, 2 month and 3 month of age, with 5 day anticipation or delay being accepted.

Ethical approval was given by the University Hospital Committee of Medical Ethics, and consent obtained from the infant's mother prior to inclusion in the study.

RESULTS

All preterm and fullterm infants presented a sequential development of postural control during their first three months of age. A thorough analysis (Table 1 and 2) up to the third month of age, shows that seven preterm infants and eight fullterm infants presented a change in their level of motor ability in supine. The preterm infants persisted in asymmetry and demonstrated more extended posture than the fullterm infants which is shown by the presence of a larger number of preterm infants in Level 2.

A change in prone was also verified in nine preterm infants and nine fullterm. In this position, the performance of the preterm infants got closer to that of fullterm infants, however, the position maintenance was less long-standing.

The infants who remained at the same supine and prone ability level improved their competence of movements, in a slow way, but never without any progress.

In sitting, two preterm infants were classified at Level 1 during their first month of age, due to the difficulty in bringing them to the seated position when pulled by their arms. These infants did not fix their pelvis on the surface for the trunk to tilt; on the contrary, they slipped forward. In the third month of age all infants were at Level sitting 2. Although no change of ability levels were observed for this position, a progress on extension capacity was acquired so that the infants could keep themselves upright.

In 19 cases (95%), a change from one ability level to another occurred right after the infants completed the previous stage. One preterm child in prone position, for instance, moved from Level 2 (in the second month) to Level 4 (in the third month).

The infants presented changes in the ability from one level to another in both prone and supine positions, simultaneously, in 12 occasions out of 74 observations.

A link between lying (prone and supine) and sitting was found; infants who had reached Levels 3 and 4 in prone and supine were still at Level 2 for sitting.

No significant differences within the groups were found using the Cochram Q Test . A comparative study of the groups using the Wilcoxon Test (Table 3) also showed no significant statistical difference, except for Level 1 supine position (inability to maintain the back on the table and therefore rolling laterally) which showed a significant difference between fullterm and preterm groups at 15 days.

DISCUSSION

In this study, the existing relationship between the acquisition of new motor patterns and move-

Table 1. Preterm group: motor ability levels.

Case	AGE											
	Day 15			Month 1			Month 2			Month 3		
	sup	pron	sit	sup	pron	sit	sup	pron	sit	sup	pron	sit
1	n/a	n/a	n/a	2	2	1	2	2	2	2	3	2
2	1	2	1	2	2	2	3	2	2	4	4	2
3	n/a	n/a	n/a	2	2	2	2	2	2	3	3	2
4	1	2	2	2	2	2	3	3	2	3	3	2
5	2	2	2	2	2	2	3	2	2	3	3	2
6	1	1	2	2	2	2	2	2	2	2	2	2
7	2	1	2	2	2	2	2	2	2	2	3	2
8	n/a	n/a	n/a	2	2	2	2	2	2	2	3	2
9	1	2	2	2	2	2	n/a	n/a	n/a	2	2	2
10	1	1	2	n/a	n/a	n/a	2	2	2	2	3	2

sup, supine; values 1,2,3,4, levels of abilities; pron, prone; sit, sitting; n/a, not attended.

Table 2. Fullterm group: motor abilitiy levels.

Case	AGE											
	Day 15			Month 1			Month 2			Month 3		
	sup	pron	sit	sup	pron	sit	sup	pron	sit	sup	pron	sit
1	2	2	2	2	2	2	2	2	2	2	3	2
2	1	1	2	1	2	2	2	2	2	3	3	2
3	1	1	2	2	2	2	3	2	2	3	3	2
4	2	1	2	2	2	2	3	3	2	3	3	2
5	2	2	2	2	2	2	2	3	2	3	3	2
6	2	2	2	2	2	2	3	2	2	n/a	n/a	n/a
7	2	2	2	2	2	2	2	2	2	3	3	2
8	2	1	2	2	1	2	2	2	2	2	3	2
9	2	1	2	2	2	2	3	3	2	4	4	2
10	2	1	2	2	2	2	3	3	2	3	3	2

sup, supine; values 1,2,3,4, levels of abilities; pron, prone; sit, sitting; n/a, not attended.

ments with alterations in the load bearing areas and weight shift was observed. This last factor helped explain the slight differences observed between the preterm and fullterm infants. Although in statistical terms the preterm infants presented a sequence in the development of postural control similar to that of the fullterm infants, and were within the age range at each level showed by Pountney et al.[3] for normal infants, they presented a different trend in the acquisition of motor abilities.

Detailed observations of motor development were recorded using the instrument designed by the Chailey Heritage team[3,4]. A very rich range of spontaneous movements by preterm infants as well as fullterm infants was observed. However, the motor performance of some preterm infants at the same level of ability proved to be less mature. It is believed that the occurrence of Level 1 in supine position, for the preterm infants, is a response to a less organized behavioral condition observed by excessive move-

Table 3. Comparison of levels of ability between preterm and fullterm groups.

Evaluation	n (PT)	n (FT)	Wilcoxon test p-value
Supine15d	7	10	0.0455*
Prone15d	7	10	0.5354
Sitting15d	7	10	0.2821
Supine1m	9	10	0.3991
Prone1m	9	10	0.3991
Sitting1m	9	10	0.3428
Supine2m	9	10	0.5045
Prone2m	9	10	0.1814
Supine3m	10	9	0.1763
Prone3m	10	9	0.3590

d, day; n, number of cases; m, month; p-value, descriptive level.

ments when the infants were undressed and changed places (on lap, cushioned platform and table). It showed that they needed some kind of constraint to help them come in contact with something so that the lateral position would be favorable to a flexion, which seems to be more protective for them. One may also consider that in their first months of age, the preterm infant's transversal trunk diameter may be similar to the anteroposterior diameter and that their muscle mass may be reduced to adapt the back to the surface.

Some of the preterm infants, at the age of three months, still remained at Level 2 in supine position due to a less developed flexion than the one observed in fullterm infants. There seems to be no consensus in explaining the more extended position of preterm infants in supine. Several authors suggest it is due to a global muscle tone lower than normal[9,10]; others to an increased muscle power of the trunk extensors[11-14]; and one to lack of tactile and proprioceptive stimulation as a result of the limited intra-uterine space at the end of pregnancy[11]. All these suppositions could change the adequate muscle control to overcome the influence of extra-uterine gravity. Supine load bearing varied, according to the level, from trunk, pelvis and feet.

The group of preterm infants had more difficulty in maintaining a long-lasting position, in prone, and soon expanded the areas of load bearing, demanding less participation of head and limbs to explore the environment. Without the displacement of weight towards the lower parts of the body, in prone, such as the lower abdomen and pelvis, these body segments would not be able to adapt and favor stability and, consequently, they would not allow the limbs to change their roles according to the context. This observation is supported by Pountney et al.[3] who stated in their work that motor development is evidenced by the change from one ability to another followed by other concurring changes in trunk, head and limbs control.

It is not possible to make any conclusive statements in the presence of Level 1 at the sitting position (as observed in two of our preterm infants). It was an occasional occurrence observed in the corrected first month of age. Afterwards, the infants could be placed in the sitting position (Level 2). The presence of Level 1 did not impede the acquisition of other abilities such as lying and sitting, up to the third month of age. However, a longer follow up period is needed. In Green et al.[4], Level 1 was observed only in infants with cerebral palsy and not in normal infants. This data was consistent with our control group.

Different from preterm infants, most fullterm infants presented a more harmoniously rounded trunk and their acquisition of a more upright position seemed to be more mature. The analysis of the videos confirmed that there was a longer-lasting attempt to keep the trunk upright in the fullterm infants. For the preterm infants this attempt was inconsistent and brief as if they were losing their muscle tone degree.

The 3-month-old infants who participated in this research did not present the ability to sit independently (Level 3), although two of them reached Level 4 for supine and prone, probably because their abilities were not mature enough and needed a longer time to improve the balance of their extension and flexion components. According to Bly[15], the more rectified dorsum in the sitting position may be related to the improvement of the performance of the trunk extending activity in prone by normal infants.

The preterm infants also presented hyperextension of the neck whereas the fullterm already showed less hyperextension, which proved that there was an improvement of the antigravity control of the flexing and extending muscles of head and neck, consequently, increasing head and shoulder alignment. Load bearing on the ischial tuberosities was predominant in all infants in the sitting position.

In Pountney et al.[3], assessments took place every week up to week 6 of age, and every fortnight, up to month 9, or whenever the infant could move from lying to sitting (Level 6 for lying position),and the observation of preterm and fullterm groups was recorded every fifteen days during the first month and every month up to the third month. Thus, according to Chailey Heritage research team, the changes from one to the subsequent ability level in lying and sitting positions were observed as soon as they emerged and the connection among them was established.

Variations of Level 1 and 2 between the 15th day and one month of age, in the supine and prone positions, were related to the physiological muscle tone and not to the changes of patterns that could justify significant differences in the acquisition of abilities. The infants were close to stable during a couple of weeks and, from month 2 on, it was possible to observe changes in the levels, thus evidencing the acquisition of new motor behaviors (Levels 3 and 4). The authors of this study agree with the Chailey Heritage team as to the statements of Prechtl[16] that the birth of an infant is not accompanied by great alterations in neurological and behavioral repertories but a dramatic neurological change occurs at the end of the second month of life, although during their first months of life the infants keep many fetal motor characteristics and only between the 8th and 10th weeks of age does the antigravity posture become apparent.

The use of Chailey Levels of Abilities is appropriate for infants with cerebral palsy as well as for was preterm ones. This study represents the first phase of a much broader follow up study with preterm and fullterm infants; nevertheless, all infants in this research are being longitudinally studied to verify whether the development of postural control of preterm infants continues to evolve according to the patterns presented by their control group, that is, fullterm infants.

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