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Comparison of Motor Development of Preterm and Full Term Infants

Eunju Lee, MS, PT[1)], HwangBo Kak, PhD, PT[2)],
TaeYoung Oh, PhD, PT[3)], Hyolyun Roh, PhD, PT[4)]

[1)]*Major in Physical Therapy, Department of Rehabilitation Science, Graduate School Daegu University*
[2)]*Department of Physical Therapy, College of Rehabilitation Science, Daegu University*
[3)]*Department of Physical Therapy, College of Medical Life Science, Silla University*
[4)]*Department of Occupational Therapy, Kangwon National University: 3 Hwangio-ri, Samcheok-si, Gangwondo, 245-907 Republic of Korea.*
TEL: +82 33-540-3481, FAX: +82 33-572-8620, E-mail: withtry@kangwon.ac.kr

Abstract. [Purpose] This study compared the motor development characteristics of preterm and full term infants, for utilization basic material for the mediation of the early physiotherapy of high-risk infants. [Subjects and Methods] The subjects were preterm and full-term infants who were hospitalized at the nursery of Busan M Hospital from March 30th, 2010 to December 31st, 2010. The group of mature infants (male: 8; female: 9; postconceptional age: 39.24 weeks) and premature infants (male: 10; female: 7; postconceptional age: 40 weeks) were measured for movement and posture using the Test of Infant Motor Performance (ver. 5.0) and the assessment was performed at the postconceptional age of 40 weeks (mean age: 39.75 weeks). [Results] In some items of the observed scale and elicited items, the mature group exhibited better motor development than the premature group. Also, in the overall score of the observed scale, the performance of the premature group was below that of the mature group. [Conclusion] Even healthy premature infants with no neurological issues show reduced levels of development compared to mature infants.
Key words: Motor development, Premature infant, Test of infant motor performance

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INTRODUCTION

Early identification of children who are at risk of developmental delays is a primary focus of physical therapy for preterm infants[1)]. Early identification and mediation of development delay can minimize the issues afterwards with long-term function enhancement and promote enhanced school adaptation, self-esteem, and family functions[2)]. Also in Korea, the importance and necessity of early mediation of preterm infants have been recognized, and early physiotherapeutic mediation is being executed in some hospitals[3,4)]. However, the recognition for the necessity of early physiotherapy is still inadequate. Thus, precise and appropriate evaluation of preterm infants and the understanding of development characteristics of preterm infants along with evidence on the effectiveness is necessary. However, the assessment of motor development during the first three months of life in infants born at term, and in those born at preterm, is still a challenge for physical therapists[5)]. One of the new assessment methods being used in Korea, the Test of Infant Motor Performance (TIMP) was developed by Campbell and colleagues[6)]. It was designed for use with prematurely born infants from 32 weeks gestational age up to about 4 months after term-equivalent age, or for full-term infants up to 4 months of age[7),] as they interact with people, objects, and their environment[8)]. In this study, TIMP was used to compare the development characteristics of preterm infants and full-term infants. The results should furnish basic material for the early physiotherapy mediation of high risk infants.

SUBJECTS AND METHODS

The subjects of this study were 34 full-term and preterm infants (male: 18; female: 16) hospitalized at the nursery of Busan S Hospital from March 30th to December 31st, 2010. They were infants who received conventional nursing treatments in the nursery, and the assessments were performed at the postconceptional age of 40 weeks (mean age: 39.75 weeks) (Table 1). The infants' vital signs' stability were confirmed by pediatric specialists, and infants with periventricular hemorrhage and leukomalacia , infections or genetic abnormalities or malformations were excluded from the study. The full-term group consisted of 17 infants (male: 8; female: 9; mean age: 39.24 weeks) with gestational ages of over 37 weeks, weight at birth of over 2.5 kg, no diseases at birth, and hospitalized at the nursery for 3 days or longer; 10 delivered by Cesarean section and 7 by regular delivery, and the average age of the mothers was 31.88 ± 4.40 years. The preterm group consisted of 17

Table 1. Birth medical history (M ± SD)

	FT (n=17)	PT (n=17)	t
Gestational Age (weeks)	38.6 ± 0.7	34.2 ± 2.3	**
Birth Weight (kg)	3.1 ± 0.3	1.9 ± 0.5	**
Birth Height (cm)	49.4 ± 1.7	43.0 ± 3.7	**
Birth Head Circumference (cm)	33.8 ± 1.5	30.3 ± 2.0	**
Apgar Score (1min)	7.7 ± 0.8	6.4 ± 1.1	**
Apgar Score (5min)	8.7 ± 0.6	8.1 ± 0.7	**
Age (month)	7.0 ± 2.5	6.3 ± 2.2	

**: $p<0.01$, FT: Full term, PT:Preterm.

infants (male: 10; female: 7; mean age: 40 weeks) with gestational ages of below 37 weeks, weight at birth of below 2.5 kg, no congenital deformation or chromosomal anomaly, no special brain damage with circumventricular hemorrhage level 2 or lower and hospitalization at the infant intensive care unit; 13 were delivered born by Cesarean section 4 by regular delivery, and the average age of their mothers was 30.12 ± 4.11 years. TIMP (ver. 5.0) was used in this study. It is a testing tool aiming to diagnose infants with risk of motor development delay because of sensitivity to motor execution level and maturity change, predict future motor execution and measure mediation effects. Forty-two items are measured with a maximum possible score of 142 points, and average measurement time takes 33 minutes (SD ± 12). For the 13 observed items, 1 is attributed if the motion for each item is observed, or 0 if not. For the 29 elicited items, the examiner induces the motion and the generated response is scored from 0 to 6 for each item. At the time of TIMP development, its reproducibility was 0.89 ($p<0.001$), and the inter-examiner reliability was 0.949, with single examiner reliability in the range of 0.980~0.996.

Three physiotherapists with over 5 years of experience in pediatric physiotherapy and over 1 year of experience in early physiotherapy mediation in infant ICU instructed themselves via CD-ROM according to the guidelines of the TIMP Test User's Manual (version 5.0). All observations and executions were made at stages 3 and 4 of Brazelton (1984) which is recommended as the most appropriate awareness state for assessing the actions of infants. One physiotherapist with over 3 years of experience in early physiotherapy in the infant ICU and over 10 years experience in pediatric physiotherapy performed the assessment and it was videotaped and all 3 physiotherapists gathered together for scoring; and their inter-examiner reliability was within the range of 0.95. Ethical approval was given by the Pusan Marie Hospital Committee of Medical Ethics, and consent was obtained from infants' mothers prior to their inclusion in the study. The results of this study were analyzed using SPSS 12.0 for Windows program and the significance level *a* for all statistics was chosen as 0.05. For the general characteristics of the study subjects, averages were calculated. The chi-square test was used to analyze the observed items and Mann-Whitney test was used to analyze the elicited items.

RESULTS

A comparison of birth histories by group is given in Table 1. The gestational period was 38.6 ± 0.7 weeks in the full-term group, and 34.2 ± 2.3 weeks in the preterm group ($p<0.01$). The weight at birth was 3.1 ± 0.3 kg in the full-term group, and 1.9 ± 0.5 kg in the preterm group ($p<0.01$). The height at birth was 49.4 ± 1.7 cm in the full-term group and 43.0 ± 3.7 cm in the preterm group ($p<0.01$). The head circumference at birth was 33.8 ± 1.5 cm in the full-term group and 30.3 ± 2.0 cm in the preterm group. The 1-minute Apgar score at birth was 7.7 ± 0.8 points in the full-term group, and 6.4 ± 1.1 points in the preterm group ($p<0.01$). The 5-minute Apgar score was 8.7 ± 0.6 points in the full-term group, and 8.1 ± 0.7 points in the preterm group ($p<0.01$). The age was 7.0 ± 2.5 months in the full-term group, and 6.3 ± 2.2 months in the preterm group. Therefore, physical growth and Apgar score were significant different between the full- term group and the preterm group. The motor execution score of the 13 observation items are shown in Table 2. Among the observed items, fidgety movement was better in the full-term group than preterm group. In the full-term group, fidgety movement was observed, but not in the preterm group. The overall score of the observed scale did not show a significant difference between the full-term group and the preterm group. The scoring of elicited items is given in Table 3. The items of head control-anterior neck muscles, head control-lowered from sitting, defense reaction-arm movement, pull to sit, lateral straightening of the head and body with arm support, lateral hip abduction reaction prone suspension, prone suspension, head lift in prone showed better motor development in the full-term group than in the preterm group. The overall score of elicited items showed a significant difference between the full-term group and the preterm group.

DISCUSSION

This study compared the development characteristics of preterm infants and full-term infants for use as basic material in the early physiotherapy mediation of high-risk infants. In this study, preterm infants with no neurological issues at a postconceptional age of 40 weeks were given low scores compared to full-term infants in some items of TIMP. Eliane et al.[5] observed preterm infants and full -term infants for 3 months, and noted that both developed equally

Table 2. A comparison of TIMP at observed items (M ± SD)

	FT (n=17)	PT (n=17)	x^2
1. Head in Midline : Head is held within 15° of midline for at least 2 seconds	0.3 ± 0.5	0.5 ± 0.5	0.48
2. Individual Rt. Finger Movement: Individual finger movement is noted in the Rt hand without other joint movements (any position)	1.0 ± 0.0	1.0 ± 0.0	0.00
3. Individual Lt. Finger Movement: Individual finger movement is noted in the Lt hand without other joint movements (any position)	1.0 ± 0.0	1.0 ± 0.0	0.00
4. Fingers objects or surfaces with Rt hand (any position)	1.0 ± 0.0	1.0 ± 0.0	0.00
5. Fingers objects or surface with Lt hand (any position)	1.0 ± 0.0	1.0 ± 0.0	0.00
6. Bilateral Hip and Knee Flexion: Demonstrates bilateral hip and knee flexion so that the feet clear the support surface	1.0 ± 0.0	1.0 ± 0.0	0.00
7. Isolated Rt. Ankle Movement: Demonstrates isolated Rt. ankle movement without other joint movements (any position)	1.0 ± 0.0	1.0 ± 0.0	0.00
8. Isolated Lt. Ankle Movement: Demonstrates isolated Lt. ankle movement without other joint movements (any position)	1.0 ± 0.0	1.0 ± 0.0	0.00
9. Reciprocal Kicking: Demonstrates reciprocal kicking with both legs off the support surface	0.7 ± 0.5	0.5 ± 0.5	1.12
10. Fidgety Movement: Demonstrates on ongoing flow of small, minute movement occurring in every part of body and showing great variety with frequent changes of direction	0.4 ± 0.5	0.1 ± 0.2	4.50*
11. Ballistic movement of the arm or legs (swipes or swats)	0.0 ± 0.0	0.0 ± 0.0	0.00
12. Oscilliation of arm or leg during movement. A movement cycle lasts 0.5–1sec	0.1 ± 0.2	0.0 ± 0.0	1.03
13. Reaches for Person or Object: While in supine or sitting, reaches for and contacts a person or object presented at the midline	0.1 ± 0.2	0.0 ± 0.0	1.03
Total observed Score	8.5 ± 0.9	8.1 ± 0.7	4.49

*: $p<0.05$, FT: Full term, PT: Preterm.

but the level of development was slower in the preterm group. In the present study, full-term infants and preterm infants were different in fidgety movement (11 items). It appears that preterm infants move individual body segments less selectively than full-term infants. The observed items score behaviors reflecting infants' spontaneous attempts to change position or to orient the body in various ways, selective movement of individual body segments, and performance of qualitative types of movements[10].

Performance of elicited items reflects an infant's ability to solve movement "problems" posed to elicit evidence of developing postural control in a variety of spatial orientations[7]. The differences in head control-anterior neck muscles (item 17 of Table 3), head control-lowered from sitting (18), defensive reaction-arm movement (26), pull to sit (32), lateral straightening of the head and body with arm support (33), lateral hip abduction reaction (34), prone suspension (35), lateral hip abduction (36) of the elicited items between full-term infants and premature infants were significant. Many of these items assess the ability to control the head and trunk in several spatial orientations and in response to interesting stimuli in the environment[6]. Head control is an important aspect of postural development in the early months of life and is frequently impaired in children with cerebral palsy. An infant's ability to independently control head position in a variety of spatial orientations and in response to a variety of sensory and social stimuli is important[7]. Preterm infants have more difficulty in maintaining a long-lasting position in the prone position, and soon expanded the areas of load bearing, demanding less participation of head and limbs to explore the environment[5]. Also when suspended in the prone position to assess their ability to flex their arms from an extended position in a prone posture, they showed evidence

Table 3. A comparison of TIMP at elicited items (M ± SD)

	FT (n=17)	PT (n=17)	z
14. Head Rotation Side to Side	1.00 ± 0.0	0.9 ± 0.2	1
15. Head Control -Supported Sitting	2.1 ± 0.3	1.4 ± 0.7	3.33
16. Head Control -Posterior Neck Muscles	2.1 ± 0.3	1.9 ± 0.6	1.32
17. Head Control -Anterior Neck Muscles	2.1 ± 0.33	1.0 ± 3.5	5.24**
18. Head Control -Lowered from Sitting	2.0 ± 0.0	0.9 ± 0.7	4.66**
19. Rt. Inhibition of Neonatal Neck Righting	0.9 ± 0.5	0.9 ± 0.7	0.25
20. Lt. Inhibition of Neonatal Neck Righting	0.9 ± 0.5	1.0 ± 0.5	0.70
21. Head in Midline without Visual Stimulation	2.1 ± 2.2	1.9 ± 0.6	0.80
22. Head Held in Midline with Visual Stimulation	0.7 ± 0.5	1.0 ± 0.6	1.47
23. Rt. Supine Neck Rotation	0.7 ± 0.5	0.8 ± 0.5	0.63
24. Lt. Supine Neck Rotation	0.7 ± 0.5	0.9 ± 0.6	0.86
25. Defensive Reaction-Head and Neck Response	2.8 ± 0.4	2.9 ± 0.3	0.48
26. Defensive Reaction-Arm Movement	1.0 ± 0.0	1.5 ± 0.5	3.19**
27. Hip and Knee Flexion	2.1 ± 0.2	1.9 ± 0.4	0.99
28. Rt. Rolling: Elicited from the Legs	2.5 ± 0.7	2.7 ± 0.8	0.66
29. Lt. Rolling: Elicited from the Legs	2.8 ± 0.8	2.8 ± 0.6	0.11
30. Rt. Rolling: Elicited from the Arms	2.7 ± 0.5	2.7 ± 0.6	0.12
31. Lt. Rolling: Elicited from the Arms	2.8 ± 0.4	2.8 ± 0.7	0.16
32. Pull to Sit	2.6 ± 0.5	1.9 ± 0.2	3.74**
33. Lateral Straightening of the Head and Body with Arm Support	0.8 ± 0.4	0.1 ± 0.2	4.42**
34. Lateral Hip Abduction Reaction	0.7 ± 0.5	0.2 ± 0.4	3.06**
35. Prone Suspension	2.0 ± 0.0	1.5 ± 0.5	3.19**
36. Head Lift in Prone	2.0 ± 0.0	1.6 ± 0.5	2.93**
37. Crawling	1.4 ± 0.5	1.4 ± 0.7	0.56
38. Rt. Head Turn in Prone to Sound	1.1 ± 0.2	1.0 ± 0.0	1.0
39. Lt. Head Turn in Prone to Sound	1.1 ± 0.3	1.1 ± 0.3	0.00
40. Standing	1.6 ± 0.5	1.4 ± 0.7	0.61
41. Rt. Lateral Head Righting	1.9 ± 0.5	1.7 ± 0.5	1.35
42. Lt. Lateral Head Righting	1.8 ± 0.4	1.6 ± 0.5	1.08
Total elicited Score	48.8 ± 3.0	43.4 ± 2.6	4.29**

*: $p<0.05$, **: $p<0.01$, FT: Full term, PT: Preterm.

of developing postural control in sitting and side-lying positions[6].

Therefore, it was shown that even healthy premature infants with no issues such as periventricular hemorrhage and leukomalacia, infections or genetic abnormalities or malformations exhibited reduced development levels compared to mature infants. Thus, early development mediation for preterm infants seems to be highly necessary.

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