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ORIGINAL ARTICLE

Comparing early physiotherapy results between term and preterm at-risk infants

Nilay ÇÖMÜK BALCI, Zafer ERDEN, Mintaze KEREM GÜNEL

Purpose: Early physiotherapy reduces neuromotor problems in at-risk infants. This study was planned to compare the effects of an early goal-directed neuromotor physiotherapy (GDNT) application between preterm and term at-risk infants.
Methods: Eighteen at-risk infants between the ages of 0 and 12 months were assigned to the preterm and term groups according to their gestational and corrected age. Each group received GDNT for 45 min, three days per week for 12 weeks. The effectiveness of the therapy was measured using the Alberta Infant Motor Scale (AIMS), the Hammersmith Infant Neurological Examination (HINE), and Goal Attainment Scale (GAS).
Results: Both groups improved significantly in postural control and neuromotor aspects after treatment ($p<0.05$). No differences were found in AIMS, HINE, and GAS findings between the groups ($p>0.05$).
Conclusion: The GDNT can enhance neuromotor development in at-risk term and preterm infants, and gestational age does not have any effect on the neurodevelopmental outcomes of the early rehabilitation.
Keywords: Infant, Risk, Rehabilitation.

Premature ve zamanında doğan bebeklerde erken fizyoterapi sonuçlarının karşılaştırılması

Amaç: Riskli bebeklerde erken fizyoterapi nöromotor problemleri azaltmaktadır. Bu çalışma, erken dönem hedefe yönelik nöromotor fizyoterapinin etkinliğini, premature ve zamanında doğan bebekler arasında karşılaştırmak amacıyla planlandı.
Yöntem: Yaşları 0-12 ay arasında olan 18 riskli bebek, yaşları ve gestasyonel yaşlarına göre premature doğan ve zamanında doğan gruplarına ayrıldı. Her grup 12 hafta boyunca haftada 3 gün, günde 45 dk erken dönem hedefe yönelik nöromotor fizyoterapi yaklaşımı içeren tedavi aldı. Terapilerin etkinliği Alberta Infant Motor Scale (AIMS), Hammersmith Infant Neurological Examination (HINE), ve Goal Attainment Scale (GAS) kullanılarak değerlendirildi.
Bulgular: Her bir grupta tedavi öncesine göre tedavi sonrasında tüm değerlendirmelerde postüral kontrol ve nöromotor yönden anlamlı gelişme kaydedildi ($p<0.05$). Gruplar arasında AIMS, NSMDA ve GAS sonuçları arasında fark bulunmadı ($p>0.05$).
Tartışma: Erken dönem hedefe yönelik nöromotor fizyoterapi yaklaşımı, premature doğan ve zamanında doğan riskli bebeklerde nöromotor gelişimi desteklemektedir ve erken rehabilitasyonun nörogelişimsel sonuçları üzerinde gestasyonel yaşın etkisi bulunmamaktadır.
Anahtar kelimeler: İnfant, Risk, Rehabilitasyon.

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N Çömük Balcı: Başkent University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, Ankara, Türkiye.
Z Erden, M Kerem Günel: Hacettepe University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, Ankara, Türkiye.
Corresponding author: Nilay Çömük Balcı: nlycmk@yahoo.com
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At-risk infants are characterized by having negative environmental and biologic factors that contribute risk of neurodevelopmental disorders and mortality. Conditions such as intrauterine growth restriction, periventricular leucomalacia, intraventricular hemorrhage, chronic lung disease, twins or triplets can cause risk of morbidity and mortality for preterm at risk infants. Perinatal asphyxia, hypoxic ischemic encephalopathy, seizures, meningitis, and hyperbilirubinemia are usually related to term at-risk infants.[1,2]

Early physiotherapy provides minimizing developmental delays, remediate existing or emerging disabilities such as cerebral palsy and minor neurologic dysfunction in infants from birth to 24 months of age. The major advantage of early period in the life is that the brain plasticity is considered to be very high at this time. [3,4] Early physiotherapy have the aim of optimizing motor development and modifying sensory information and anomalous movement patterns in order to improve motor development.

Early goal directed neuromotor physiotherapy (GDNT) is referred to as 'task-oriented' and is built on contemporary system theories of motor control.[5] The development and learning of new skills occur in an interaction between the child, and the task to be performed, and the particular environment in which the activity takes place.[5,6] Studies showed that goal directed therapy has positive effects on motor development in children with neurologic conditions.[7-10]

Due to the health conditions at birth, at-risk infants may require hospitalization in the neonatal intensive care units to ensure their survival. However, hospital environment with intense lighting, and excessive noise, and performance of painful procedures, are constant source of stress especially in preterm infants.[11,12] Therefore, the environment of excessive and prolonged stimulation during brain development brings many consequences for preterm infants including long-term attention and learning difficulties, difficulty remaining in an active or inactive behavioral state of alertness and in regulating sleep patterns.[13] Thus, due to the diversity of risk factors in the development of at-risk infants during the first year of life, it is necessary to use accurate evaluation methods with a high predictive value for alterations and early rehabilitation to enhance neurosensorymotor development. With regard to neuromotor development, it was observed that there are differences in the rate of skill acquisition of preterm infants when compared to term infants. In follow-up programs, until 12 months of corrected age, preterm infants have lower scores in gross motor development.[14] Several studies showed the effects of early physiotherapy in preterm infants.[15-20] However, we do not know if the effect of early physiotherapy approaches differ between term and preterm at-risk infants. To this end, the aim of this study was to compare the effect GDNT between term and preterm at-risk infants.

METHODS

Settings and Participants

This study was conducted at Hacettepe University, Department of Physiotherapy and Rehabilitation, Ankara, Turkey, between December 2013 and December 2014. Ethical approval was obtained from the ethics committee of Hacettepe University (GO13 186-01). The data were collected after informed parental consent.

Eighteen at-risk infants between the ages of 0 and 12 months were assigned to the preterm and term groups according to their gestational and corrected age. Infants attended to groups according to their level of risk. The level of risk is determined by the Criteria of Turkish Neonatology Association.[21]

Inclusion criteria were:

- being diagnosed as "at-risk" by a pediatric neurologist, having intraventricular hemorrhage, periventricular leucomalacia, hypoxic ischemic encephalopathy, and prematurity, Apgar score of 5 or less at 5 min, chronic lung disease, seizures, meningitis, hyperbilirubinemia, being twins or triplets, and having intrauterine growth restriction;
- being outside of the neonatal intensive care unit;
- being between 0 and 12 months old (corrected age for premature infants);
- having a family acceptance for the participation in 12 weeks of therapy program.

Exclusion criteria were:

- having congenital anomalies, musculoskeletal disorders, cyanotic congenital heart disease and mechanical dependency, and
- lack of informed content by the parents.

Measurements

The effectiveness of the therapy and postural control and neuromotor aspects of infants were measured using the Hammersmith Infant Neurological Examination (HINE), Alberta Infant Motor Scale (AIMS) and Goal Attainment Scale (GAS).

The Hammersmith Infant Neurological Examination (HINE): The HINE was used for the assessment of all infants enrolled in this study. It includes three sections: the neurological examination, the development of motor function and the state of behavior. The first section evaluates cranial nerves, posture, movements, tone, and reflexes. These items are not age-dependent. The second section evaluates head control, sitting, voluntary grasping, rolling, crawling and walking. The third section evaluates state of consciousness, emotional state, and social orientation. The data obtained in the second and third sections are not included in the calculation of global optimality scores. The overall score ranges from a minimum of 0 to a maximum of 78.[22,23]

The Alberta Infant Motor Scale (AIMS): Gross motor development was assessed using the AIMS. This scale is an observational tool designed for the evaluation of gross motor development and postural control in infants from birth to 18 months of age or the acquisition of independent walking. It consists of 58 items and four subscales: supine (9 items), prone (21 items), sitting (12 items) and standing (16 items), which are observed in postural alignment, antigravity movements, and surface contact. The motor skills observed correspond to the infant's motor window consisting of all items located between the less and more mature capabilities observed in the motor repertoire. Assessment was based on free observation of the child in different positions (prone, supine, sitting, and standing) according to the age. The obtained score is form 0 to 60 points.[24,25]

The Goal Attainment Scale (GAS): The GAS method required practitioners to set rehabilitation goals in collaboration with the client and family or significant others, such as a caregiver. For each goal, client and practitioner developed detailed and very specific observable and quantifiable descriptions of possible outcomes. Five outcome levels were identified, including expected or desired level of performance or outcome, two levels that would be seen as less favorable, and two levels that were more favorable. The five recommended outcome levels for each goal were assigned numeric values from -2 (the least favorable outcome) to +2 (the most favorable outcome). The expected outcome or goal was assigned 0. The client and practitioner reviewed the outcome after the planned intervention or a predetermined length of time, and a score between –2 to +2 was allocated to that goal.[26,27]

Intervention

Each group received GDNT for 45 min, three days per week for 12 weeks by a physiotherapist who was a neurodevelopmental treatment approach therapist. The terapist and family chose the best goal for the baby together according to infant's age and capabilities. Each goal for each baby was SMART (specific, measurable, attainable, relevant, timed).[7] The goals are defined specific for each of the babies (Table 1). The groups also received home program including positioning and handling of infants applied by the families.

Statistical analysis

The statistical software SPPS 20 (IBM Corp. Released 2011. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY) was used for calculations. All values presented as mean±standard deviation and frequencies. The Chi-square test or Fisher's exact test (when chi-square test assumptions do not hold due to low expected cell counts), where appropriate, was used to compare proportions in different groups. Two groups were compared using Mann-Whitney U test. Within group comparison was performed using Wilcoxon signed rank test. Descriptive level of significance was a p value of <0.05.

RESULTS

Nine children were in the preterm group and nine children were in the term group. Demographic and physical characteristics of

infants were shown in Table 2. The proportions of preterm and term infants were presented by gender, level of risk and delivery method using cross tabulations (Table 2). In Table 2, gender and risk levels of infants and delivery method showed no statistical difference between preterm and term infants ($p>0.05$). Gestational age and birth weight in preterm group were significantly lower than those of term group ($p<0.05$, Table 2). There were no significant differences in infant's age, maternal and paternal age between the two groups ($p>0.05$, Table 2). Both groups improved significantly in postural control and neuromotor aspects after the treatment compared to pretreatment ($p<0.05$) (Table 3). No difference was found in the AIMS, HINE and GAS findings between the groups ($p>0.05$, Table 3).

DISCUSSION

Our primary findings indicate that GDNT has beneficial effects on neurological and motor development, postural control and antigravity movements in term and preterm at-risk infants. However, neurodevelopmental results of early physiotherapy do not differ between the two groups.

In the past few decades the importance of early physiotherapy has become widely recognized. Studies showed the effect of intervention in children with at risk for developmental disorders. Ohgi et al.[18] found early physiotherapy program has beneficial effects on neonatal neurobehavioural development and maternal mental health of low birth weight infants with cerebral injuries. Nelson et al.[28] and Badr et al.[29] showed central nervous system injured experimental infants tended to exhibit better motor and mental performance than control group. Heathcock et al.[20] and Park et al.[17] also concluded that neonatal developmental intervention program promote motor and growth outcome of premature infants. Similarly, our results indicate that GDNT improved motor and neurological development in term and preterm at risk infants.

Early physiotherapy programs in the previous studies include neurodevelopmental treatment approach, home program, family-centered therapy, and constrained induced movement therapy. In this study, GDNT is used to directly address the infant's limitations in everyday life situations. Thereby the infant's possibilities to actively participate in daily life activities increase with normalized movements and transfer to improved skill performance. Today the emphasis during treatment is more directed to functional activities, and the infant is given the possibility to be more of an active problem solver.[30] Neurodevelopmental aspect of the GDNT comes from Bobath's approach that includes facilitation and normalization of the movement, sensory motor components of muscle tone, increasing postural control and decreasing abnormal movement patterns. Studies in which the effect of a goal or activity-focused therapy has been investigated show promising results. Löwing et al.[7], Ahl et al.[8], and Ketelaar et al.[31] investigated the effects of goal directed therapy in children with spastic serebral palsy (CP) for at least 12 weeks, and found scientific improvements in daily motor performance, gross motor functions, daily life activities, and functional independence of children with CP. Recently, Sorsdahl et al.[9] have applied goal directed group therapy approach for three weeks in children with CP. Despite the short-time duration, functional independence scores of children increased. Similarly, Storvold et al.[10] showed that six week of treatment with goal directed therapy has positive effects on motor development in children. Our results also demonstrated enhancement in neurologic and motor development and postural control of the infants in term and preterm infants. Encouragement of to allow the infants to play on a mattress and provide opportunities to for exercise of the infants' muscles promoted motivation to be active for this population.

There are studies comparing motor development outcomes between term and preterm infants. Pin et al.[32] found that, although at eight months of age preterm infants exhibit motor performance similar to term infants in the prone and supine postures, there was a difference between groups in the sitting and standing postures, which makes greater demands on the antigravity musculature and on motor control. de Kieviet et al.[33] showed that preterm children without CP perform almost one standard deviation lower than their peers on standardized motor

Table 1. Example of the Goal Attainment Scale.

Level of expected outcome	Goal 1
+2 (Much greater than expected outcome)	Reaching for toy with trunk rotation in independent sitting position
+1 (Greater than expected outcome)	Reaching for toy without trunk rotation in independent sitting position
0 (Expected outcome)	Sitting independently
-1 (Less than expected outcome)	Reaching forward and sideways in supported sitting position
-2 (Baseline)	Feet to mouth in supine position

Table 2. Demographic properties of infants and maternal and parental age of parents.

	Preterm (N=9) Mean±SD	Term (N=9) Mean±SD	p
Gestational age (weeks)	30.01±2.91	38.83±1.48	<0.001
Infant's age (months)	6.54±3.48	5.68±3.22	0.626
Birth weight (gr)	1331.11±492.37	3186.66±542.74	<0.001
Maternal age (years)	33.00±4.52	30.55±5.89	0.214
Paternal age (years)	36.33±6.96	34.88±8.97	0.533
	N	N	
Gender (Girls/Boys) (n)	6/3	3/6	
Level of risk			
High	6	6	
Moderate	2	2	
Low	1	1	
Delivery method			
Normal	7	4	
Cesarean	2	5	

Table 3. Comparison of treatment scores within and between the groups.

		Preterm (N=9) Mean±SD	Term (N=9) Mean±SD	p
Alberta Infant Motor Scale	Before treatment	12.22±7.32	9.55±5.81	0.247
	After treatment	33.55±20.37	24.33±14.94	0.184
	p	0.007*	0.007*	
Hammersmith Infant Neurological Examination	Before treatment	41.72±11.56	43.88±14.55	0.825
	After treatment	67.16±5.56	67.44±8.70	0.450
	p	0.007*	0.007*	
Goal Attainment Scale	Before treatment	-1.55±0.52	-1.55±0.52	1.000
	After treatment	0.88±1.16	0.77±1.30	0.851
	p	0.006*	0.006*	

* p<0.05.

assessments at preschool and school age, and have higher rates of mild-to-moderate motor impairment than their term-born peers. In the study of Lorefice et al.[34], very preterm children showed a significant increase in postural sway when their eyes were open and closed, had impaired static and dynamic balance compared with term children. However, no study has compared the motor development results of term and preterm at-risk infants. Our study demonstrates that gestational age does not affect the rehabilitation outcomes of at-risk infant Level of risk and the amount of brain injury may affect the neurodevelopmental results of early physiotherapy.

Limitations

The limitations of this study were that the lack of long-term follows up of the infants and the small sample size. Also, our study doesn't include control group because of ethical issues. Further studies needed to conduct with large sample size and future follow up programs.

Conclusion

The present study indicated that early physiotherapy in infants at-risk of developmental disabilities is beneficial for neurodevelopmental outcomes. The GDNT has positive effects on neurological and motor development, postural control, and antigravity movements in both term and preterm at-risk infants. However, neurodevelopmental results of GDNT do not differ between term and preterm infants. Maybe, the level of risk, the amount of brain injury or any other conditions much more determine the effect of early physiotherapy outcomes than the gestational age of infants.

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