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Araştırma Makalesi / Research Article

Assessment of Relationship Between Retinopathy of Prematurity Severity and Visual Motor Integration

Prematüre Retinopatisi Şiddeti İle Görsel Motor Entegrasyon Arasındaki İlişkinin Değerlendirilmesi

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Abstract

Aim: The aim of the current study is to assess the effects of retinopathy of prematurity (ROP) severity on visual motor integration in children.
Material and Methods: Totally 104 children (44 girls, 60 boys) between 2 and 6 chronological age were included in the study. The children's mean gestational age was 28.75±2.67 and birth weight was 1252.92±411.33. The Beery-Buktenica Developmental Test of Visual Motor Integration with supplemental tests of Visual Perception and Motor Coordination were used for the assessment of children.
Results: The incidences of retinopathy of prematurity severity were 23.1% Stage 1+, 24% Stage 2+ and 52.9% Stage 3+ in the study. The incidence of abnormal visual motor integration was 51% of the study population. The incidence of abnormal visual perception and motor coordination were 37.5% and 51.9%, respectively. Referring to the Beery-Buktenica Developmental Test of Visual Motor Integration results, there was statistically significant correlation between the level of all visual motor integration, visual perception, and motor subtest results (p=0.00). There were not statistically significant correlation between retinopathy of prematurity severity and results of visual motor integration and visual perception tests (p>0.05). There was a significant correlation between retinopathy of prematurity severity and motor coordination test results (p<0.05).
Conclusion: This study shows that as the retinopathy of prematurity severity increases, motor coordination skills are negatively affected in preterm born children at pre-school ages.

Key words: Retinopathy of prematurity; Visual-motor integration; Visual perception; Motor coordination

Öz

Amaç: Bu çalışmanın amacı, prematüre retinopatisi şiddeti ile çocukların görsel motor entegrasyon becerisi arasındaki ilişkisinin incelenmesidir.
Materyal ve Metot: Çalışmaya, kronolojik yaşı 2 ile 6 yaş arasında toplam 104 çocuk (44 kız, 60 erkek) dahil edildi. Çocukların ortalama gebelik yaşı 28,75±2,67, doğum ağırlığı 1252,92±411,33'idi. Beery-Buktenica Gelişimsel Görsel Motor Entegrasyon testi ile Görsel Algı ve Motor Koordinasyon alt testleri kullanıldı.
Bulgular: Çalışmada prematüre retinopatisinin şiddetine göre çocukların % 23,1'i Evre 1+, %24'ü Evre 2+ ve %52,9'u Evre 3+'idi. Anormal görsel motor entegrasyon insidansı çalışma popülasyonunun %51'idi. Anormal görsel algı ve motor koordinasyon insidansı sırasıyla % 37,5 ve %51,9'idi. Beery-Buktenica Gelişimsel Görsel Motor Entegrasyon Testi sonuçlarına göre, görsel motor entegrasyon, görsel algı ve motor koordinasyon alt test sonuçları arasında istatistiksel olarak anlamlı bir ilişki vardı (p=0,00). Prematüre retinopatisi şiddeti ile görsel motor entegrasyon ve görsel algı test sonuçları arasında istatistiksel olarak anlamlı ilişki yoktu (p>0,05). Prematüre retinopatisi şiddeti ile motor koordinasyon testi sonuçları arasında istatistiksel olarak anlamlı bir ilişki vardı (p<0,05).
Sonuç: Bu çalışma, okul öncesi dönemdeki preterm doğumlu çocuklarda prematüre retinopatisinin şiddeti arttıkça, motor koordinasyon becerisinin olumsuz yönde etkilendiğini göstermektedir.

Anahtar Kelimeler: Prematüre retinopatisi, Görsel motor entegrasyon, Görsel algı, Motor koordinasyon

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INTRODUCTION

Despite advances in neonatal medicine and higher survival rate of preterm infants, visual impairment is still an important cause of morbidity and the absolute numbers of very preterm infants with Retinopathy of Prematurity (ROP) have also been rising (1, 2).

Preterm born children have an increased risk for developing ocular problems such as myopia, retinal detachment, and strabismus. Moreover, the incidences of ocular morbidities were reported to be associated with the stage of ROP (3).

Retinopathy of Prematurity, which is caused by abnormal development of retinal blood vessels, is an important cause of avoidable blindness in preterm born children (2). Children with severe ROP are more likely to experience decreased vision, strabismus / amblyopia or refractive error, both of which can impact Visual-Motor Integration (VMI) (4). Children born preterm show poorer performance in tasks such as motor skills, (5-7) Visual Perception (VP) (6,8) and VMI, (5,9) when compared to full-term born children at the same age.

Visual-Motor Integration, VP, and fine motor difficulties can affect reading and writing skills during schooling. In particular, learning and reading disabilities are closely linked to VMI difficulties, and therefore the assessment of such skills is critical for children who are suspected of being at risk of reading disabilities in school settings (10). These difficulties can continue into later childhood (11-13) and are also seen in adulthood (14).

Few studies have explored the potential correlation between the ROP severity and VMI skill (4, 15, 16). Goyen and colleagues studied VMI and motor skills in 45 children with stages 1–3 ROP at three years of age. Poor eye-hand coordination and fine motor skills in preterm infants are likely to be due to their extreme prematurity and was not found to vary significantly as a result of ROP severity (4). Therefore, the other study found that fine motor skills activities in children with zone 1 ROP had a statistically lower score relative to those with zone 2 ROP. (15). Pétursdóttir et. al. assessed VMI in young adults who have previously diagnosed with ROP, with a birth weight ≤1500 g, aged 25-29 years.

This research indicates VMI has been impaired in young adults born preterm (13). However, all premature born children with or without ROP and/or brain damage are at higher risk of impairments in these areas relative to full-term born children and can benefit from early screening. (4, 9).

To our knowledge, there is no research that investigated the relationship between VMI, VP, motor coordination and ROP severity in children aged between 2 and 6 years. In this study, our hypothesis is that the VMI, VP and motor coordination ability worsens when the ROP severity increases. Our aim is to investigate the relationship between ROP stage and VMI, VP and motor functions.

MATERIAL AND METHODS

This study was approved by non-interventional clinical research ethics committe of the Istanbul Medipol University with the number 10840098-604.01.01-E.16521 and was conducted in accordance with the principles laid out in Declaration of Helsinki. Written and oral informed consents were obtained from the parents before the assessments.

This study included children with a diagnosis of ROP between 2013 and 2017 in Zeynep Kâmil Maternity and Children's Diseases Training and Research Hospital, which is a tertiary referral center for ROP patients in Turkey. In the first month of life, all were tested for ROP and treated with laser therapy or the anti-vascular endothelial growth factor (Anti-VEGF) as necessary. All premature children in the study received standard ROP screening examinations at 4 weeks following birth based on international guidelines (17). All children were selected from the patient records in the same hospital and invited to the study by telephone call. Children between 2 and 6 years with a gestational age under 34 weeks were included in the study. Children who did not show enough cooperation during VMI assessment, children with a history of ocular disease other than ROP and/or with any neurologic, congenital and metabolic diseases were excluded from the study.

Demographic and clinical data of children including gender, gestational age and birth weight were recorded. Stage and zone of ROP was recorded according to the most affected eye. The Beery-Buktenica Developmental Test (BBDT) of VMI was used to determine the VMI, VP and motor coordination (MC) levels of the children. The Beery VP and MC tests were administered individually after the Beery VMI - Short Form test. A booklet with a series of 30 progressively complicated geometric figures was presented to the participants, from vertical line to a three-dimensional star. In the VP test the participant were required to define the exact copy of each of the 27 geometric types across many variants. The MC test was performed that various shapes can be tracked with a pencil without moving past the double-lined paths. Using the total score and the child's chronological age, VMI, MC and VP levels are determined as "very low, low, below average, above average, above average, high, very high" according to normative values in the instruction manual of the test (18). A trained physiotherapist (S.K.) who was blinded in the study measured each test independently and anonymously.

Statistical Analysis

Data were analyzed using SPSS 21.0 statistical package. Descriptive analysis were used for clinical characteristics. Normally distributed variables were compared using Spearman correlation test. "p" value of less than 0.05 and 0.01 was considered statistically significant. In the statistical analysis Spearman correlation test were used for correlation between the BBDT subtest scores and correlation between ROP stage and the BBDT subtest scores analysis.

RESULTS

The clinical characteristics of the study population are shown in Table 1. There were 44 (42.3%) girls, 60 (57.7%) boys. Gestational age and birth weight average were 28.75±2.67 weeks and 1252.92±411.33 grams, respectively. The incidences of ROP stage were 23.1% Stage 1+, 24% Stage 2+ and 52.9% Stage 3+ and ROP zone were 4.8% Zone 1, 70.2% Zone II and 25% Zone III in the study. There were 74 cases that were received Anti-vascular endothelial growth factor therapy (n:15) or Laser therapy (n:59) in the postpartum period.

Table 1. Clinical characteristics of the study population

	Mean±SD (min. - max.)
Age (months)	57.75 ± 11.02 (24 - 72)
Gestational age (weeks)	28.75 ± 2.67 (24 - 34)
Birth weight (g)	1252.92 ± 411.33 (560 - 2290)
	N (%)
≤1000 (ELBW)	34 (32.7%)
1001-1500 (VLBW)	42 (40.4%)
1501-2000 (LBW)	28 (26.9%)
Sex	**N (%)**
Girls	44 (42.3%)
Boys	60 (57.7%)
Eye ROP zone	**N (%)**
Zone I	5 (4.8%)
Zone II	73 (70.2%)
Zone III	26 (25.0%)
Eye ROP stage	**N (%)**
Stage 1+	24 (23.1%)
Stage 2+	25 (24.0%)
Stage 3+	55 (52.9%)
ROP Treatment	**N (%)**
AntiVEGF	15 (14.4%)
Laser	59 (56.7%)
Non-treatment	30 (28.8%)

Abbreviations: LBW, Low birth weight; VLBW, very low birth weight; ELBW, extremely low birth weight; SD, standard deviation; min, minimum; max, maximum; g, gram

The subtest results of VMI, VP and MC were summarized in Table 2. The incidence of abnormal VMI were 51% (n:53) of study population. The incidence of abnormal VP and MC were respectively 37.5% (n:39) and 51.9% (n:54) of study population.

The correlation of VMI, VP and MC subtest results were provided in Table 3. Referring to the BBDT results, there were significant correlation between level of all VMI, VP and MC subtest results (p=0.00). The correlation between ROP stage and the BBDT subtest results were shown in Table 4. No significant correlation was observed between ROP stage and VMI and VP subtest results (p>0.05). There were statistically significant correlation between ROP stage and MC subtest results (p<0.05).

Table 2. Visual Motor Integration, Visual Perception and Motor Coordination Results of study population

The BBDT Subtest Results		
Visual Motor Integration		**N (%)**
Abnormal	Very low	6 (5.8%)
	Low	15 (14.4%)
	Below average	32 (30.8%)
	Total	**53 (51.0%)**
Normal	Average	48 (46.2%)
	Above average	3 (2.9%)
	Total	**51 (49.0%)**
Visual Perception		
Abnormal	Very low	12 (11.5%)
	Low	13 (12.5%)
	Below average	14 (13.5%)
	Total	**39 (37.5%)**
Normal	Average	49 (47.1%)
	Above average	11 (10.6%)
	High	3 (2.9%)
	Very high	2 (1.9%)
	Total	**65 (62.5%)**
Motor Coordination		
Abnormal	Very low	20 (19.2%)
	Low	8 (7.7%)
	Below average	26 (25.0%)
	Total	**54 (51.9%)**
Normal	Average	50 (48.1%)
	Total	**50 (48.1%)**

Abbreviations: BBDT, Beery-Buktenica Developmental Test

Table 3. Corelation of visual motor integration, visual perception and motor coordination subtest results

BBDT subtests		n	r	p
VMI	VP	104	0.458	0.00*
	MC	104	0.516	0.00*
VP	VMI	104	0.458	0.00*
	MC	104	0.367	0.00*
MC	VMI	104	0.516	0.00*
	VP	104	0.367	0.00*

*Spearman corelation test, p<0.01. Abbreviations: BBDT, Beery-Buktenica Developmental Test; VMI, Visual motor integration; VP, Visual perception; MC, Motor coordination

Table 4. Correlation between ROP stage and the Beery-Buktenica Developmental subtest results

	BBDT subtests	n	r	p
ROP stage	VMI	104	-0.079	0.427
	VP	104	0.023	0.816
	MC	104	-0.221	0.024*

*Spearman correlation test, p<0.05. Abbreviations: BBDT, Beery-Buktenica Developmental Test; ROP, Retinopathy of Prematurity; VMI, Visual motor integration; VP, Visual perception; MC, Motor coordination

DISCUSSION

Prematurity causes a damaging effect on visual function. The effects of prematurity and ROP can result with mild/moderate and severe visual impairment (19). In this study, it was observed that the severity of ROP was not related to VMI and VP ability but it was related to MC ability. It was also observed that VMI, VP and MC functions in children with ROP were impaired, which is compatible with previous research involving children and adolescents (13, 20).

Pétursdóttir et. al. measured VMI in young adults previously diagnosed with ROP. They were found that the preterm individuals were shown to have significantly poorer scores than the full-term controls in the all subtests of BBDT (13). In this study, 51.1% of children showed abnormal VMI, 37.5% abnormal VP and 51.9% abnormal MC function was compatible with the literature. Prematurity appeared to have life-long effects and this research indicates that VMI was impaired in children born preterm at pre-school ages.

There are relatively few studies on VMI function in preterm born children, who were prospectively diagnosed with ROP in infancy and examined throughout childhood. Molloy et. al. stated significantly lower performance in VP function in adolescents aged 14 to 20 born extremely preterm compared to the controls (12). Additionally, the findings showed that extremely preterm children with severe ROP are at increased risk for ongoing visual processing difficulties (21), which was in accordance with the present study. From this point of view, we believe that it is important to follow up the children who are followed up with the diagnosis of ROP in terms of visual motor skills between 2 and 6 years in the preschool period. Compared to infants born full-term, preterm infants are at higher risk of cognitive and motor dysfunction (22). It has been reported in the literature that visual-motor dysfunction is associated with fine motor difficulties in preschool children with very low birth weight (20). It points out that abnormal visual motor integration, visual perception and motor coordination skills, children with ROP may encounter difficulties in handwriting, fine motor skills, motor coordination and academic skills.

Also, we showed that there were correlation between ROP stage and motor coordination ability between 2 and 6 years. This result shows that the motor coordination skills of children with severe ROP stage are affected. For this reason, it is thought that they need to develop with the treatment programs that support visual habilitation and motor development.

In future studies, detailed studies can be carried out on preschool programs to treat the consequences of ROP associated with visual motor integration difficulties.

There are some limitations in this study. Neurodevelopmental assessment methods that assess children's cognitive, language, gross and fine motor skills were not used. Apart from this, since neonatal intensive care epicrisis could not be reached in all children, findings such as Apgar score, mechanical ventilation duration,

hospitalization time, previous sepsis attacks and other premature birth morbidities that may affect visual motor integration skills were not evaluated and discussed.

CONCLUSION

The present study reported that visual perception, motor coordination and visual motor integration and have been impaired on children with ROP between 2 and 6 years. In this study our hypothesis is accepted that motor coordination ability worsens when the ROP severity increases. The VMI, VP and MC functions affects each other and, the impaired visual motor integration function influence handwriting, fine motor and academic skills of the prematurely born children.

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Conflict of Interest: *The authors declare that they have no competing interest.*

Ethical approval

Non-interventional clinical research ethics committe of the Istanbul Medipol University approved with the number 10840098-604.01.01-E.16521.

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