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Pain Management with ROP Position in Turkish Preterm Infants During Eye Examinations: A Randomized Controlled Trial

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ABSTRACT

Purpose: The purpose of this study was to evaluate the effects of infant positioning on pain, heart rate, oxygen saturation and crying time during examination.
Design & methods: The randomized controlled experimental study was carried out on 70 preterm infants. ROP position + pacifier was used in the experimental group ($n = 35$) while only the pacifier was used in the control group. Heart rates, oxygen saturation, crying duration and pain score (Premature Infant Pain Profile-PIPP) were evaluated before, during and after the screening.
Results: The preterm infants in the experimental group recorded lower pain scores at the beginning of the screening ($p = 0.01$), at the end of the screening ($p = 0.01$) and after screening ($p = 0.01$) than those in the control group. The heart rate was higher in the control group during screening ($p = 0.010$) and after screening ($p = 0.008$) than in the preterm infants in the experimental group. Oxygen saturation was not significantly different between the groups before, during or after screening. Crying duration was lower in the experimental group than in the control group ($p = 0.010$).
Conclusions: Positioning of the infant to support behavioral organization was found to be effective in reducing pain and shortening crying time during eye examination, and had favorable effects on physiological variables with ROP position during eye examinations.
Practice implications: ROP position is a practical and effective non-pharmacological method during eye examinations by neonatal nurses.

Introduction

Retinopathy of prematurity (ROP) is often seen ın preterm infants. There are many factors in the development of the disease, especially prematurıty and low birth weight and ıt characterized to the incomplete vascular development and abnormal vascularization of the retina (Hellström, Smith, & Dammann, 2013). Incidences of ROP vary between developed and developing countries (Darlow, Gilbert, & Quiroga, 2013). The incidence rate is high in China, Southern and Southeastern Asia, and particularly in Latin America and Eastern Europe, where there is a high rate of preterm delivery. It has been reported that 20 out of 100 babies develop retinopathy in Latin America and the Caribbean (Arnesen, Duran, Silva, & Brumana, 2016). Liu et al. (2014) report a retinopathy incidence rate of 41.2% in preterm infants born ≤28 weeks of gestation and a rate of 64% in extremely low birth weight (ELBW) preterm infants in China; Al-Alawi, Al Omran, and Al Bahrana (2015) reported an incidence rate of 40.1% and 6.7% in ELBW and very low birth weight (VLBW) preterm infants; and Hwang, Lee, and Kim (2015) reported a 34.1% incidence rate for retinopathy of any stage in VLBW preterm infants and a rate of 54% in ELBW preterm infants weighing 750–1000 g in Korea.

The incidence rate in Turkey is similar to that of other developing countries. The Turkish Neonatal Society and the Turkish Ophthalmological Association emphasize that more mature infants in terms of gestational age develop advanced stage ROP than in developed countries (Turkish Guidelines on Retinopathy of Prematurity, 2016). In a multicenter study conducted in 2014, a prevalence rate of 52.8% was reported in preterm infants with a gestational age of ≤28 weeks, and 42% in VLBW preterm infants (Bas et al., 2015), whereas in a study by the TR-ROP group conducted in 69 centers, the prevalence rate was reported to be 21.6% in infants with a gestational age of ≤24 weeks and 26% in preterm infants weighing ≤1000 g (Bas et al., 2018).

The American Academy of Pediatrics (AAP), American Academy of Ophthalmology (AAO), American Association of Pediatric Ophthalmology and Strabismus and American Association of Certified Orthoptist recommend retinopathy screening for preterm infants with a birth weight (BW) of ≤1500 g and/or gestational age (GA) of ≤30 weeks, and all preterm infants with a GA of >30 weeks and BW of

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1500–2000 g who have a poor general medical condition and who have undergone cardiopulmonary supportive therapy (AAP, AAO, AAPOS, AACO, 2013). In Turkey, the Turkish Neonatal Society and the Turkish Association of Ophthalmology all recommend preterm infants with a GA of ≤32 weeks and birth weight of ≤1500 g, as well as preterm infants with a GA of >32 weeks and BW of >1500 g who have received cardiopulmonary supportive therapy, or who are considered by the attending clinician to be at risk for the development of ROP, be included in the scope of screening (Turkish Guidelines on Retinopathy of Prematurity, 2016).

Retinopathy screening is often carried out using the binocular indirect ophtalmoscopy (BIO) method, which is a painful procedure for the preterm infant. The use of an eyelid speculum, scleral depression, application of pressure on the globe and traction of extraocular muscles increases the intensity of the pain felt by preterm infants during screening examinations (O'Dwyer, 2011). Various physiological changes can occur due to pain during or after screening (Mitchell, Green, Jeffs, & Roberson, 2011). The most commonly reported sign of pain is an increased heart rate and a decrease in oxygen saturation (Mitchell et al., 2011; Sun, Lemyre, Barrowman, & O2Connor, 2010). Previous studies have found lid speculum insertion to be the most painful part of the procedure (Mandel, Ali, Chen, Galic, & Levesque, 2012). The insertion and movement of the speculum increases oxygen demand and heart rate in preterm infants (Sun et al., 2010), and the physiological instability observed after an examination persists for the following 24 h, increasing incidences of vomiting, apnea, gastric residuals, increase in oxygen demand and temporary changes in the heart rate (Mitchell et al., 2011; Sun et al., 2010).

Recent studies have reported on the use of pharmacological and non-pharmacological pain management methods before or during screening examinations (Sun et al., 2010), including non-nutritive sucking, swaddling, oral glucose and oral sucrose solutions, breast milk, inhaled nitric oxide, topical anesthetic drops, newborn individualized developmental care and assessment programs, and infant positioning (reversed kangaroo mother care) (Boyle et al., 2006; Cogen et al., 2011; Da Costa et al., 2013; Dilli et al., 2014; Mandel et al., 2012; Mitchell et al., 2004; O'Sullivan, O'Connor, Brosnahan, McCreery, & Dempsey, 2010; Padhi et al., 2015; Ribeiro et al., 2013). These methods are generally used alone, but studies using a combination of these methods have reported more effective pain control (Francis, 2016; Kandasamay, Smith, Wright, & Hartley, 2011). Among these, sucrose, non-nutritive sucking, swaddling and topical anesthetic drops are the most commonly used methods (Francis, 2016).

The World Health Organization (WHO) recommends effective pain management primarily through a "Newborn Individualized Developmental Care and Assessment Program (NIDCAP)" (Al-Alawi et al., 2015). Placing the newborn in a supine, prone or lateral position with the arms on the head, and supporting the legs within a nest or a rolled towel are practices that maintain physiological stability and make the infant feel secure (King & Norton, 2017). Immobilizing the head of the preterm infant during a screening examination and positioning the infant while maintaining hand-arm coordination are important nursing interventions that support behavioral organization of the infant (King & Norton, 2017; Kleberg et al., 2008). Other studies into infant positioning have involved the application of other non-pharmacological methods, based on reversed kangaroo mother care (Padhi et al., 2015) and facilitated tucking (Ribeiro et al., 2013).

In comparison to routine care, the Newborn Individualized Developmental Care and Assessment Program (NIDCAP) during eye screening examinations in neonatal intensive care units provides a more effective organization of a preterm infant's behaviors (Francis, 2016). NIDCAP procedures during screening examinations include environmental planning, sound and noise control, lighting control, preparation of the preterm infant for examination, application of mydriatic eye drops, monitorization of vital findings, offering babies who accept breastfeeding a preemie pacifier for soothing, positioning of the preterm infant, head immobilization during screening examination, supporting the head with side pads, supporting self-soothing, maintaining the heart rate and oxygen saturation within normal ranges, and oxygen supplementation on demand (Kleberg et al., 2008).

The therapeutic positioning of preterm infants is an important intervention that can be performed by neonatal nurses, and supports the developmental care of a preterm infant (King & Norton, 2017). The positioning of the infant and supporting its developmental care during screening examination includes comforting the baby, wrapping the legs in a nest or swaddling in the shape of a cocoon, and bracing the legs (Kleberg et al., 2008). The insertion of the eyelid speculum, scleral depression, traction of extraocular muscles and pressure applied to the globe require the minimal hyperextension of the head and the effective immobilization of the preterm infant's head during examinations (O'Dwyer, 2011). It is also suggested that in NIDCAP Care; immobilization performed with minimum pressure, and with the head bed aligned in the midline and supported with soft rolls to facilitate the immobility (Kleberg et al., 2008).

There ıs no well-defined or a specific position ın the lıterature that can be used for pain management during eye examinations. A specific position which is called 'ROP Position' used in the study. It is a physiological flexion position that supports the behavioral organization of the preterm infant, and that increases the comfort and the feeling of security in the infant during examinations. And also in clinical applications ıt can be used as a well-defined and specific position on pain management in NIDCAP care during eye examinations.

ROP position

The position is attained by two nurses holding the upper and lower extremities of a preterm infant in a certain position. Positioning the upper extremity involves head immobilization and the clenching of the arms with the head. While positioning the head, a cotton-staffed rolled pad is used to close the gap between the shoulders and the head while the head is slightly hyperextended. The elevation provided by this pad supports the little fingers of the nurse and facilitates the immobilization of the head in the midline. The arms of the infant are flexed with the left hand placed on the left temporal region and the right hand on the right temporal region of the head, and the nurse gently clenches the head and hands while the arms are flexed.

The positioning of the lower extremities is performed by another nurse, who gently grasps to cocoon the infant with the legs flexed at the knees, and the feet dorsiflexed while approximating the lower extremities to the midline. This allows the physiological flexion posture of the lower extremity (Picture 1).

The ROP position involves an ideal holding position in which the lower extremities of a preterm infant are held by the nurse in the

Picture 1. ROP position.

shape of a cocoon, as recommended in the NIDCAP approach, with the head immobilized and the preterm infant allowed to touch its own face. Minimal hyperextension of the head facilitates the visibility of the retina and the maneuvers made during screening (O'Dwyer, 2011). Hyperextension of the head distinguishes the ROP position from that indicated in the NIDCAP approach, and allows the nurse to support the physiological flexion position of a preterm infant and to support individual organization through touching and making the infant feel secure.

This study evaluates the effects of infant ROP positioning developed by the researchers that support the behavioral organization of the infant in terms of pain, heart rate, oxygen saturation and crying time, before, during and after the screening examination of preterm infants.

Material and methods

The study was designed as a randomized, controlled experimental study. It was conducted in the neonatal intensive care unit of the Maternity and Children Training and Research Hospital in İstanbul between April 2015 and January 2016. Each preterm infant included in the study was examined by the same ophthalmologist. During the eye examination in the unit, proparacaine HCL 0.5% topical anesthetic drops were applied to control pain during the examination, and no non-pharmacological methods were used. The preterm infants meeting the following inclusion criteria were included in the study; (a) with a birth weight of ≤2000 g, (b) with a gestational age of ≤34 weeks according to the last menstrual period, (c) with a postmenstrual age of 28–36 weeks during the screening examination, (d) who had not received mechanical ventilation support in the last 72 h (e) with no demand for oxygen, (f) who were clinically stable, and (g) who accepted breastfeeding. Preterm infants receiving positive-pressure mechanical ventilation (Boyle et al., 2006) and those with stage III or IV intracranial hemorrhage or other such neurological or genetic disorders as leukomalacia (Ribeiro et al., 2013), preterm infants under sedation and those with transient tachypnea and severe bronchopulmonary dysplasia, preterm infants with dyspnea and intercostal or subcostal retractions and those with nasal cannula/hood or oxygen demand in the incubator (Dilli et al., 2014), preterm infants with a congenital anomaly or gastrointestinal tract disorder preventing appropriate positioning, such as omphalocele, gastroschisis, osteogenesis imperfecta or necrotizing enterocolitis, and preterm infants with an extremity fracture were excluded from the study.

Sample size and randomization

The sample size was calculated based taking into account other studies examining similar variables (Noordzij, Dekker, Zoccali, & Jager, 2011). In the power analysis, considering the pain scores (Group1: 15.3 ± 1.9; Group2: 14,3 ± 1.6; Group3: 12.3 ± 2.9; Group4: 12.1 ± 3.4; $p = 0.023$)reported in the study by Boyle et al. (2006) comparing sucrose and non-nutritive sucking, and the pain scores (Group1: 13.7 ± 2.1; Group2: 16.4 ± 1.8; $p = 0.001$) and crying times (Group1: 58.7 ± 16.6 s; Group2: 79.8 ± 30,4 s; p = 0.001) reported in the study by Dilli et al. (2014).The power analysis based on the mean PIPP scores reported in the study by Boyle et al. (2006) showed that a total of 50 preterm infants, with each group comprising at least 25 infants, must be included with an effect size of d = 0.527 and a power of 95.5% within a 95% confidence interval. The power analysis based on the mean difference of 30 s in crying time in the study by Dilli et al. (2014) showed that a total of 58 preterm infants, with each group comprising at least 29 infants, must be included with an effect size of d = 0.67 and a power of 95% within an 80% confidence interval. The sample size was based on the mean difference in crying time, as the number of preterm infants assigned to each group was higher with this power analysis. The target sample size was increased by 20% considering dropouts, and the study group was composed of a total of 70 preterm infants, each comprising 35 preterm infants. The randomization was performed using a computer software and no blinding method could be implemented as data collection was carried out by the first researcher, and both the researcher and ophthalmologist were aware of the position of the preterm infants. According to the post hoc analysis, the effect of ROP positioning on pain intensity was analyzed with a power of 95% within a 95% confidence interval.

Data collection instruments

The assessment tools used in the study include the Preterm Infant Data Form, used to identify the descriptive characteristics of the preterm infants; and the Pain Assessment Form which consists Premature Infant Pain Profile (PIPP) scale. And a non-invasive pulse oximeter, preemie pacifier, video camera, examination table and tripod were also used in the study. Pulse oximeter and video camera were calibrated prior to use in the study.

Preterm infant data form

The Preterm Infant Data Form contained items to collect gender, gestational age, postmenstrual age at the time of screening, birth weight, weight at the time of screening and crying duration.

Pain assessment form/Premature Infant Pain Profile (PIPP)

The pain levels experienced by preterm infants were evaluated using the premature infant pain profile (PIPP) scale developed by Stevens, Johnston, Patrıca, and Taddio (1996). The scale assesses acute pain in term and preterm infants with a gestational age of 28–36 weeks, being a multidimensional seven-indicator composite measurement tool in which three indicators assess facial expressions, two indicators assess physiological parameters, and two indicators assess gestational age and behavioral state. The items are scored on a scale of 0–3 points. The score acquired in the scale varies depending on the gestational age of the newborn. Due to the physiological differences associated with prematurity, gestational age and behavioral state are rated inversely on a scale of 3–0 (Gibbins et al., 2014; Stevens et al., 2014). Thus, the maximum score according to the maturation level that can be acquired in the scale is 21 points in preterm infants with a GA of <28 weeks, and 18 points in term infants (Gibbins et al., 2014). In the study the pain scores of preterm infants were evaluated at four different time points with PIPP scale. The first evaluation took place 1 min prior to screening after positioning the preterm infant; the second evaluation took place the upon the placement of the speculum on the first eye; the third evaluation took place removed of the speculum from the second eye; and the fourth evaluation took place within 1 min of the screening of both eyes being completed and the preterm infant being placed in the ROP position. While the scale is scoring the gestational age was scored firstly before the procedure. The behavioral state was scored by observing the infant for 15 s immediately before the examination, at the beginning of examination, at the end of examination and after examination. However the baseline heart rate, oxygen saturatıon and facial expressions were assessed. Any changes from baseline were noted for 30 s at these time periods and the total pain scores were then calculated. Brow bulge, eye squeeze and nasolabial furrow were evaluated in the left eye during the screening of the right eye, and in the right eye during screening of the left eye. Pain scores were evaluated by two different observers as inter-rater consistency. Inter observer intraclass correlation coefficients (ICC) were determined and the relationship between pain scores was evaluated.

Non-invasive pulse oximeter

The heart rates and oxygen saturations of the preterm infants were measured using a non-invasive pulse oximeter (Masimo Rad87;

Masimo Corporation, Irvıne, California). The device has a precision of ± 3% in an inactive newborn, and data are recorded of measurements taken every 2 s. The heart rate and oxygen saturation values were recorded for 1 min before, during (from the time of the insertion of the eyelid speculum into the first eye to its removal from the second eye) and 1 min after the screening examination. All recorded data was transferred into a digital environment using TrendCom 3440 software.

Preemie pacifier

A light, curved one-piece phthalate and latex-free preemie pacifier conforming to the facial morphology was used in the experimental and control groups.

Video camera, tripod and examination table

All procedures were recorded on video during the study and the video recordings were retained by the first researcher. The video recordings were used to evaluate the inter-observer reliability of the PIPP scores and to determine the crying times of each preterm infant. The video camera was sited in a position that allowed the widest view and set in position with a tripod. The screening examinations of the preterm infants were performed on an 80 × 60 × 80 cm examination table on which the infants were placed in the supine position, enabling the positioning of the lower and upper extremities. The examination table was located in an area unaffected by lighting conditions and that did not interfere with the mobility of the screening team.

Ethical approach

Ethics Committee approval for the study, in accordance with the principles of the Declaration of Helsinki, was issued by the Ethics Committee of the hospital (IRB Number: 31.10.2014/178). Verbal and written informed consent was obtained from the parents of the infants prior to the screening examination.

Implementation of the study

The screening examinations were performed in the intensive care unit for two days of the week. On the screening days, preterm newborns were evaluated by the primary investigator for their eligibility to the study. After determining eligible preterm newborns, their descriptive characteristics were recorded on the preterm infant data form, and the preterm newborns were then randomized into the experimental and control groups according to the randomization table. Phenylephrine 2.5% and tropicamid 0.5% eye drops were applied to all preterm newborns 30 min before the screening examination to achieve pupil dilatation. The examination table was placed in the unit, and the video camera was set up, directed at the examination area, and fastened to a tripod. The preterm newborns were brought to the examination table 30 min later and monitorized with a non-invasive pulse oximeter, and the video recording was initiated. The ROP position + pacifier was used for the preterm newborns in the experimental group, with only the pacifier used in the preterm newborns in the control group. All were monitored for 1 min before the screening examination and for 1 min during and after the screening examination. The insertion of the eyelid speculum into the first eye represented the start of examination, and the removal of the eyelid speculum from the second eye denoted the end of the screening examination. At these pre-specified time points, heart rate and oxygen saturation were monitored for 1 min before the examination and for 1 min during the after the examination. The pain level was evaluated four times, within 1 min prior to the examination, at the beginning of examination, at the end of the examination, and within 1 min of the end of the examination (Fig. 1).

Data analysis

The statistical analyses were carried out using licensed Number Cruncher Statistical System 2007 (NCSS, Kaysville, Utah, USA) software. Descriptive statistics were presented as mean, standard deviation, median, frequency, ratio, minimum and maximum. The paired comparison of quantitative parameters with normal distribution was carried out using a Student's *t*-test, and the paired comparison of variables without normal distribution was carried out using a Mann-Whitney *U* test. A Yates's correction for continuity was used for the comparison of qualitative data. And a Two-Way Repeated Measures ANOVA and post hoc Bonferroni test were used to compare the repeated measurements of the heart rate, oxygen saturation and pain scores. Spearman's correlation coefficient was used to assess inter-observer reliability related to the pain scores, and intra-class correlation coefficients were calculated. A correlation coefficient of <0.39 indicates low agreement, 0.40–0.59 indicates moderate agreement, 0.60–0.74 indicates good agreement and 0.75–1 indicates excellent agreement between researcher and observers. The levels of significance are $p < 0.01$ and $p < 0.05$ (Cicchetti, 1994).

Results

Sample characteristics

The preterm infants in the experimental and control groups showed a homogeneous distribution based on descriptive characteristics. Of the preterm newborns, 54.3% were female and 45.7% were male; and the mean gestational age was 29.78 ± 2.07 weeks in the experimental group and 29.57 ± 1.89 weeks in the control group. The mean postmenstrual age at the time of the examination was 34.33 ± 1.42 weeks in the experimental group and 34.37 ± 1.47 weeks in the control group. The mean birth weight of the preterm newborns was 1189.00 ± 234.17 g in the experimental group and 1189.00 ± 320.87 g in the control group, and the mean weight at the time of examination was 1700.29 ± 255.92 g in the experimental group and 1818.71 ± 363.35 g in the control group (Table 1).

The mean crying time was 42.49 ± 18.94 s in the experimental group and 60.29 ± 32.78 s in the control group. The mean crying duration was lower in the preterm newborns in the experimental group than in the control group, and the difference was statistically significant (Table 1, $p = 0.010$).

Physiological characteristics

A comparison of the heart rate and oxygen saturation values of the groups showed that neither the heart rate nor oxygen saturation differed significantly between the groups prior to the screening examination (Table 2, $p = 0.480$), whereas there was a significant difference during (Table 2, $p = 0.010$) and after (Table 2, $p = 0.017$) the screening examination. In the paired comparisons, the mean heart rate in the experimental group increased by 4.64 ± 13.17 bpm during the examination compared to the values prior to the examination, and by 6.67 ± 14.74 bpm after the examination when compared to the values before the examination. The mean heart rate in the control group increased by 13.61 ± 16.41 bpm during the examination when compared to the values prior to the examination, and by 15.00 ± 22.72 bpm after the examination when compared to the values before the examination (Table 2). The increases in the heart rate during the examination when compared to the values before the examination, and after the examination when compared to the values before the examination, were significantly higher than those in the control group (Table 2, $p = 0.014$, $p = 0.043$).

There was no difference between the groups in terms of oxygen saturation, which is another physiological variable (Table 3). A paired comparison showed that oxygen saturation was similar across both groups

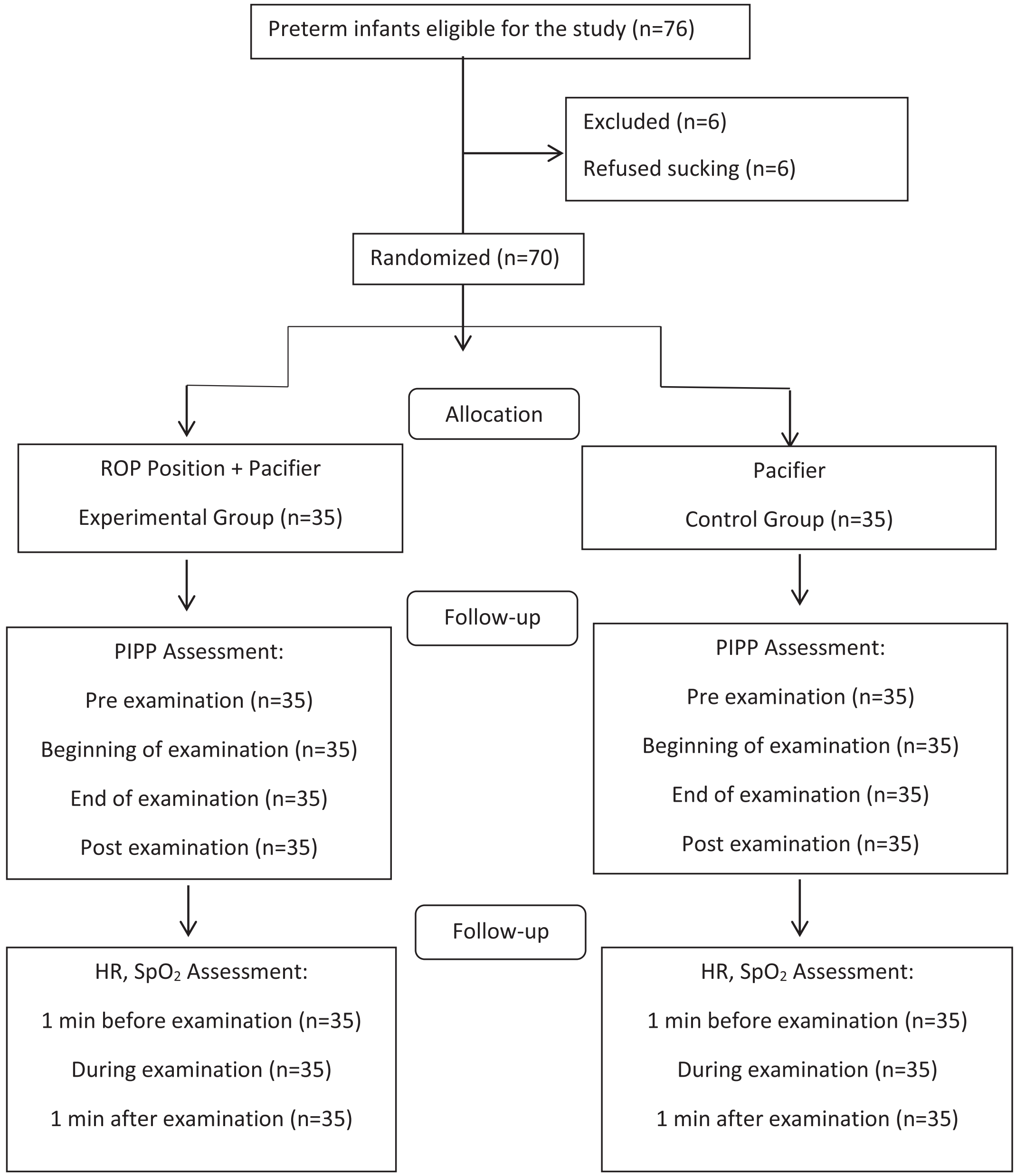

Fig. 1. CONSORT flow diagram of the randomized controlled trial.

(Table 3), whereas a change of −1.47 ± 4.62 in oxygen saturation was noted during the examination when compared to the values before the examination, and a change of 1.91 ± 4.01 after the examination when compared to the values during examination was close to statistical significance (Table 3, $p = 0.204$, $p = 0.052$).

Pain scores of preterm infants

The pain scores obtained before, at the beginning, at the end of and after the screening examination in the experimental group were lower than those obtained from the preterm infants in the control group at the beginning, at the end and after the screening examination (Table 4, $p = 0.001$, $p = 0.001$, $p = 0.003$).

In a paired comparison between the groups, the 4.17 ± 1.95-point increase in the pain score of the preterm infants in the experimental group at the beginning of the examination (p = 0.001), the 3.00 ± 2.03-point increase at the end of the examination ($p = 0.001$) and the 1.09 ± 1.22-point increase after the examination (p = 0.001) when compared to the mean score before the examination (p = 0.001) were found to be significant (Table 4, $p < 0.01$). When compared to the mean scores at the beginning of examination, the 1.17 ± 2.15-point decrease ($p = 0.004$) in the mean pain score at the end of the examination and the 3.09 ± 2.08-point decrease ($p = 0.001$) after the examination (Table 4, $p < 0.01$) were found to be significant. When compared to the values at the end of the examination, the 1.91 ± 1.70-point decrease ($p = 0.001$) in the mean pain score after the examination was also significant (Table 4, p < 0.01).

In a paired comparison in the control group, the 8.03 ± 3.68-point increase (p = 0.001) in the mean pain score of preterm infants at the beginning of the examination, the 6.31 ± 3.31-point increase ($p = 0.001$) at the end of the examination and the 2.43 ± 2.99-point increase (p = 0.001) after the examination were found to be significant when compared to the values prior to the examination. When compared to the values at the beginning of examination, the 1.71 ± 2.73-point decrease ($p = 0.004$) at the end of the examination and the 5.60 ± 3.41-point decrease ($p = 0.001$) after the examination were found to

Table 1
Comparison of descriptive characteristics of preterm infants and crying durations ($N = 70$).

Characteristics		Experimental ($n = 35$)	Control (n = 35)	Test	p
Gestational age (week)	Min–Max (Median)	25,29-33,43(30,1)	25,86–34 (30)	t:0,445	0.658[a]
	Mean ± SD	29,78 ± 2,07	29,57 ± 1,89		
Postmenstruel age (week)	Min–Max (Median)	31,14-35,86(34,6)	30–35,86 (34,7)	t:−0,104	0.460[a]
	Mean ± SD	34,33 ± 1,42	34,37 ± 1,47		
Birth weight (gr)	Min–Max (Median)	815–1800 (1150)	660–2000 (1100)	t:0,001	1.000[a]
	Mean ± SD	1189,00 ± 234,17	1189,00 ± 320,87		
Body weight at screening time (gr)	Min–Max (Median)	1310–2400 (1650)	1200–2475 (1800)	t:−1576	1.000[a]
	Mean ± SD	1700,29 ± 255,92	1818,71 ± 363,35		
		n (%)	n (%)		
Gender	Female	21 (60,0)	19 (54,3)	χ2:0,058	0.809[‡]
	Male	14 (40,0)	16 (45,7)		
Crying duration	Min–Max (Median)	16–96 (39)	14–170 (58)	Z:-2562	[*].010[b]
	Mean ± SD	42,49 ± 18,94	60,29 ± 32,78		

‡ Yates' Continuity Correction Test.
a Student *t*-Test.
b Mann Whitney *U* Test.
* $p < 0,05$.

be significant (Table 4, $p < 0.01$). When compared to the values at the end of the examination, a 3.89 ± 2.52point decrease ($p = 0.001$) was noted in the mean pain score after the examination (Table 4, $p < 0.01$).

The mean pain scores prior to the screening examination were similar in the experimental and control groups, and the mean pain scores at the beginning of the examination, at the end of the examination and after the examination were lower in the experimental group (Table 4; $p = 0.272$, $p = 0.001$, $p = 0.001$, $p = 0.003$).

Intraclass correlation coefficients for the level of agreement between the pain scores assessed by two independent observers at all time points are presented in Tables 5 and 6. The level of agreement between the researcher and first observer and between the researcher and the second observer was above 0.90 before screening, at the beginning of screening, at the end of the screening and after screening (Tables 5, 6).

In the analysis of heart rate measurements considering group and time effects, the changes across the measurement points ($p < 0.01$) and time-group interactions ($p < 0.05$) were statistically significant. The effect of the group alone on the heart rate measurement was also statistically significant ($p < 0.01$) (Table 7). But in the analysis of oxygen saturation, the time effect, time-group interactions and changes across groups were not statistically significant ($p > 0.05$) (Table 7).

In the analysis of pain scores considering the group and time effects, the changes across the measurement points ($p < 0.01$) and time-group interactions ($p < 0.05$) were significant. Similar to that observed for the heart rate, the group effect alone was also statistically significant ($p < 0.01$) (Table 7).

And also the post hoc analysis results are presented in Table 2 for heart rate, in Table 3 for oxygen saturation and in Table 4 for the pain scores.

Table 2
Comparison of the heart rates of preterm infants ($N = 70$).

Heart rate	Experimental (n = 35)		Control (n = 35)		[b]p
	Mean ± SD		Mean ± SD		
Before examination	157,47 ± 17,34		160,56 ± 18,95		0,480
During examination	162,12 ± 19,74		174,17 ± 18,09		0,010*
After examination	164,14 ± 19,17		175,56 ± 19,80		0,017*
	Mean ± SD	[d]p	Mean ± SD	[d]p	
Before-during	4,64 ± 13,17	0,134	13,61 ± 16,41	0,001**	0,014*
Before-after	6,67 ± 14,74	0,034*	15,00 ± 22,72	0,001**	0,043*
During-after	2,03 ± 15,88	1000	1,39 ± 16,43	1000	0,869

[b]Independent samples *t*-test.
[d]Bonferroni corrected post-hoc tests.
* $p < 0,05$.
** $p < 0,01$.

Table 3
Comparison of oxygen saturation of preterm infants ($N = 70$).

Oxygen Saturation	Experimental (n = 35)		Control (n = 35)		[b]p
	Mean ± SD		Mean ± SD		
Before examination	93,73 ± 4,54		94,44 ± 3,72		0,475
During examination	93,20 ± 6,88		92,97 ± 4,52		0,868
After examination	95,44 ± 5,09		94,88 ± 4,00		0,610
	Mean ± SD	[d]p	Mean ± SD	[d]p	
Before-during examination	-0,53 ± 6,37	1000	−1,47 ± 4,62	0,204	0,481
Before-after examination	1,71 ± 5,27	0,192	0,44 ± 4,31	1000	0,273
During-after examination	2,24 ± 6,03	0,106	1,91 ± 4,01	0,052	0,879

[b]Independent Samples t-test.
[d]Bonferroni corrected post-hoc tests.

Discussion

Pharmacological and non-pharmacological methods of pain management are used during the retinopathy screening of preterm infants (Sun et al., 2010), with sucrose, swaddling and non-nutritive sucking being the most commonly used methods (Francis, 2016; Kandasamay et al., 2011). Oral glucose, breast milk, inhaled nitric oxide, topical anesthetic drops, NIDCAP and infant positioning are other pharmacological and non-pharmacological methods (Boyle et al., 2006; Cogen et al., 2011; Da Costa et al., 2013; Dilli et al., 2014; Mandel et al., 2012; Mitchell et al., 2004; O'Sullivan et al., 2010; Padhi et al., 2015; Ribeiro et al., 2013). Sun et al. (2010) report that most investigators include topical applications of anesthetic drops and use of pacifiers to reduce pain during eye screening examinations in the routine care of infants. In addition to topical anesthetic drops and pacifiers, the swaddling method is also used in routine care, although this complicates the evaluation of which method is more effective (Francis, 2016).

The results of this study evaluating the efficacy of the ROP position are discussed in comparison to other studies using BIO, the application of proparacaine HCl 0.5% 30 s before examination and pacifiers (Dilli et al., 2014; Padhi et al., 2015; Ribeiro et al., 2013). Studies of infant positioning in literature have used the reversed kangaroo mother care (Padhi et al., 2015) and the facilitated tucking approaches in conjunction with other non-pharmacological methods (Ribeiro et al., 2013). Padhi et al. (2015) evaluated the effects of the reversed kangaroo mother care (R-KMC) position on physiological variables and the stress level of preterm infants through such responses of newborns as squeezing the eyes, squeezing the eyes and crying, and brow bulge and crying. The effects of the reversed kangaroo mother care position on pain were

Table 4
Comparison of PIPP scores of preterm infants ($N = 70$).

PIPP Scores	Experimental (n = 35)		Control (n = 35)		^{b}p
	Mean ± SD		Mean ± SD		
Before examination	2,34 ± 1,00		2,66 ± 1,35		0,272
The beginning of examination	6,51 ± 1,84		10,69 ± 2,99		0,001**
The end of examination	5,34 ± 1,85		8,97 ± 2,83		0,001**
After examination	3,43 ± 1,20		5,09 ± 2,51		0,003**
	Mean ± SD	^{d}p	Mean ± SD	^{d}p	
Before - beginning	4,17 ± 1,95	0,001**	8,03 ± 3,68	0,001**	0,001**
Before - end	3,00 ± 2,03	0,001**	6,31 ± 3,31	0,001**	0,001**
Before - after	1,09 ± 1,22	0,001**	2,43 ± 2,99	0,001**	0,018*
Beginning - end	−1,17 ± 2,15	0,017**	-1,71 ± 2,73	0,004**	0,448
Beginning - after	−3,09 ± 2,0	0,001**	−5,60 ± 3,41	0,001**	0,001**
End - after	−1,91 ± 1,70	0,001**	−3,89 ± 2,52	0,001**	0,001**

[b]Independent Samples *t*-test.
[d]Bonferroni corrected post-hoc tests.
The Beginning of examination: Insertion of the eyelid speculum into the first eye.
The End of examination: Removal of the eyelid speculum from the second eye.
* $p < 0,05$.
** $p < 0,01$.

not evaluated using an objective measurement tool (such as PIPP), and this was mentioned in as a limitation of their study (Padhi et al., 2015).

The study by Padhi et al. (2015) and this study differ in terms of sample size and the methods used for the assessment of pain and physiological variables. In this study, the heart rate and oxygen saturation of the preterm infants were evaluated before, during and after the screening examination using a pulse oximeter, which measures the relevant variables every 2 s, and the mean values were calculated by transferring the data into a digital environment. The study by Padhi et al. (2015) qualifies as a pilot study involving 20 preterm infants. This study, in which the ROP position was adopted and which involved 70 preterm infants, evaluated pain levels using the PIPP scale. The mean pain score in the experimental group in which the ROP position was applied was considerably lower than in the control group. In the study by Padhi et al. (2015), four preterm infants showed eye squeezing only, six showed eye squeezing and crying, two showed brow bulge and crying, and eight infants completed the screening examination without eye squeezing or crying. The authors reported that preterm infants showed temporary and mild-to-moderate levels of stress response when the reversed kangaroo mother care position was adopted, and that they were comfortable during the screening examination.

In the study by Padhi et al. (2015), oxygen saturation below 92%, an increase in the heart rate >10 beats per minute, and an increase in respiratory rate >10 breaths per minute were identified as a sign of stress response. It was reported that 60% of preterm infants experienced an increase in heart rate >10 beats per minute, 50% experienced an increase in respiratory rate >10 breaths per minute and 25% showed both responses simultaneously. No infants were reported with an oxygen saturation level below 92% in the study. Similar to the study by Padhi et al., this study reported a 10 beats/min higher mean heart rate in preterm infants when compared to the control group, and a mean oxygen saturation above 93%. Despite the methodological differences between the studies, it can be speculated that like the reversed kangaroo mother care position, the ROP position can be considered effective in providing comfort to the infant and the maintenance of physiological stability.

The randomized and controlled experimental study by Dilli et al. (2014) evaluated the ability of oral sucrose to reduce pain. In the study, 32 preterm infants in the experimental group received sucrose 24% + pacifier, while 32 infants in the control group received distilled water + pacifier, and the pain, crying time, heart rate and oxygen saturation were evaluated using the PIPP scale. The crying time was lower in the preterm infants that received sucrose 24% + pacifier than the infants who received distilled water + pacifier, with a mean crying time of 58.7 ± 16.6 s recorded in the oral sucrose group. In this study, the mean crying time in preterm infants in the ROP position + pacifier group was 42.49 ± 18.94 s, which was shorter than that reported by Dilli et al. Considering the use of a pacifier in the experimental and control groups and the similar sample sizes between the groups, the ROP position can be suggested as being more effective in the reduction of crying times than sucrose.

In the study by Dilli et al. (2014), the pain level of the preterm infants was evaluated before and during the screening examination. Dilli et al. (2014) assessed pain levels after the examination of the first eye was completed, and did not include an examination of the second eye in the pain assessment. In this study, in which the ROP position was adopted, pain was evaluated before, at the beginning, at the end and after the screening examination. The pain scores before and at the beginning of the screening examination were compared between the two groups. The mean pain score before the screening examination was 2.0 ± 0.6 in the sucrose + pacifier group and 2.34 ± 1.00 in the ROP position + pacifier group. The pain score at the beginning of the examination in preterm infants in the ROP position indicates the pain level assessed during examination of the first eye after insertion of the speculum into the first eye. Accordingly, the mean pain score was 13.7 ± 2.1 in the sucrose + pacifier group and 6.51 ± 1.84 in the ROP position + pacifier group. Based on this data, the ROP position can be considered more effective in reducing pain than sucrose.

Tachycardia, decrease in oxygen saturation, bradycardia and apnea can be observed in association with acute pain during screening examinations of preterm infants (Mitchell et al., 2011). In the study by Dilli et al. (2014), 37.5% of preterm infants in the sucrose group experienced tachycardia (>180 bpm) 18.8% experienced bradycardia (<100 bpm), and 18.8% experienced a decrease in oxygen saturation below 85%, whereas tachycardia, bradycardia and desaturation episodes occurred in a higher number of infants in the control group. The mean heart rate during the examination of preterm infants in the ROP position + pacifier group in this study was 162.12 ± 19.74 during the examination and 164.14 ± 19.17 bpm after the examination. The mean oxygen

Table 5
Intraclass correlation coefficient scores between researcher and first observer.

PIPP scores		Researcher *Mean ± SD (Median)*	First Observer *Mean ± SD (Median)*	ICC	p
Experimental n = 35	Before examination	2,34 ± 1,00 (2)	2,31 ± 0,99 (2)	0,986	0,001**
	The beginning of examination	6,51 ± 1,84 (6)	6,43 ± 1,70 (6)	0,959	0,001**
	The end of examination	5,34 ± 1,85 (5)	5,40 ± 1,70 (5)	0,946	0,001**
	After Examination	3,43 ± 1,20 (3)	3,40 ± 1,17 (3)	0,908	0,001**
Control n = 35	Before examination	2,66 ± 1,35 (2)	2,66 ± 1,35 (2)	1000	0,001**
	The beginning of examination	10,69 ± 2,99 (11)	10,51 ± 2,69 (11)	0,972	0,001**
	The end of examination	8,97 ± 2,83 (10)	9,20 ± 2,70 (10)	0,955	0,001**
	After examination	5,09 ± 2,51 (5)	9,20 ± 2,70 (10)	0,964	0,001**

ICC: intraclass correlation coefficient.
** $p < 0.01$.

Table 6
Intraclass correlation coefficient scores between researcher and second observer.

PIPP scores		Researcher *Mean ± SD (Median)*	Second observer *Mean ± SD (Median)*	ICC	p
Experimental n = 35	Before examination	2,34 ± 1,00 (2)	2,34 ± 1,00 (2)	1000	0,001**
	The beginning of examination	6,51 ± 1,84 (6)	6,49 ± 1,76 (6)	0,987	0,001**
	The end of examination	5,34 ± 1,85 (5)	5,34 ± 1,88 (5)	0,984	0,001**
	After examination	3,43 ± 1,20 (3)	3,49 ± 1,15 (3)	0,979	0,001**
Control n = 35	Before examination	2,66 ± 1,35 (2)	2,63 ± 1,37 (2)	0,996	0,001**
	The beginning of examination	10,69 ± 2,99 (11)	10,60 ± 2,79 (11)	0,991	0,001**
	The end of examination	8,97 ± 2,83 (10)	9,00 ± 2,70 (10)	0,979	0,001**
	After examination	5,09 ± 2,51 (5)	5,14 ± 2,50 (5)	0,991	0,001**

ICC: intraclass correlation coefficient.
** $p < 0.01$.

saturation was 93.20 ± 6.88 during the examination and 95.44 ± 5.09 after the examination, and no episodes of desaturation were observed. It can be suggested, based on these results, that the ROP position performs better than sucrose in maintaining the physiological variables within normal ranges, and can have favorable effects on physiological variables.

The mechanism of action of oral sucrose is that it decreases endogenous endorphin concentrations and provides better pain control when used in combination with non-nutritive sucking (American Academy of Pediatrics & Fetus and Newborn Committee, 2006). Routine care during retinopathy screening examinations often involves the use of topical anesthetic drops and pacifiers (Sun et al., 2010), and the use of the swaddling method in addition to these methods have made it difficult to determine which method is superior (Francis, 2016). The authors of this study suggest that the ROP position, which can be regarded as an alternative to swaddling, provides more effective pain management than the sucrose method, and so a comparison with the sucrose method is suggested. The authors recommend further studies be made comparing swaddling and the ROP position.

According to Synactive Theory, preterm newborns are unable to preserve a flexion posture and to maintain physiological variables within normal ranges during painful procedures, due to their anatomical and physiological immaturity. Accordingly, preterm newborns are unable to support behavioral organization during painful procedures (Als, 1986). The flexion posture of preterm infants in the ROP position supports behavioral organization. According to the Neonatal Integrative Developmental Care Model, positioning that supports developmental care preserves the posture and musculoskeletal system, and favorably effects physiological parameters (Altimier & Phillips, 2016).

Strengths and limitations

The strengths of the study include the use of a randomized and controlled study design, the number of preterm infants included in the study being higher than those in other studies (Dilli et al., 2014; Padhi et al., 2015), the position being a non-pharmacological and easily applicable method, the crying time in preterm infants being lower than in those receiving sucrose-dipped pacifier (Dilli et al., 2014), the lack of need for a preliminary preparation or intervention before positioning, the high efficacy in relieving pain, the first study to evaluate the effectiveness of positioning on pain control during eye screening examinations, and the position being a method based on touching that increases the comfort of the preterm infant and supports self-soothing.

As an important limitation of the study, the authors experienced difficulties in discussing the results of infant positioning, as this was the first study in literature to use subjective measurement methods to evaluate infant positioning. So we have recommended that other non-pharmacological and pharmacological methods as R-KMC, swaddling and oral sucrose will compare with ROP position by randomized control trials.

Conclusion

The ROP position can be considered effective in the maintenance of the oxygen saturation and heart rate of preterm infants within normal ranges. Maintaining physiological variables within normal ranges by reducing pain can be effective in decreasing crying times and in comforting the infant. The extra-uterine positioning of the infant, similar to that in the intrauterine environment with definite borders in a 360-degree confined space is important for the neurological and physiological development of an infant. Positioning preterm infants in such a way that their development is supported not only affects neuromotor and musculoskeletal development, but also supports stress reduction (Altimier & Phillips, 2016).

Although not specified within the NIDCAP approach, we recommended the ROP position as a defined, specific position that can be incorporated into NIDCAP care. It is an effective non-pharmacological means of reducing pain and comforting the infant that can be included in supportive positioning methods in clinical practice.

CRediT authorship contribution statement

Özlem Metreş: Conceptualization, Methodology, Funding acquisition, Data curation, Formal analysis, Investigation, Resources, Software, Visualization, Writing - original draft. **Suzan Yıldız:** Project administration, Funding acquisition, Writing - review & editing, Supervision, Validation.

Table 7
RM-ANOVA test results in heart rate, oxygen saturation and PIPP scores.

	Within-subject		Between-subject
	Time	Time-Group	Group
Heart rate	F = 22.415, $p < 0.001$**	F = 4.313, $p = 0{,}043$*	F = 5.240, $p = 0{,}025$*
Oxygen saturation	F = 3.461, $p = 0{,}067$	F = 1.221, $p = 0.273$	F = 0,001, $p = 0{,}977$
PIPP scores	F = 17.163, $p < 0.001$**	F = 4.057, $p = 0.048$*	F = 58.611, $p < 0.001$**

F: Repeated Measures ANOVA test.
* $p < 0{,}05$.
** $p < 0{,}01$.

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Declaration of competing interest

There is no conflict of interest.

References

Al-Alawi, E. K., Al Omran, M. S., & Al Bahrana, E. H. (2015). Incidence of retinopathy of prematurity in Bahrain, 2002–2011. *Middle East African Journal of Ophthalmology*, *22*(3), 335–339. https://doi.org/10.4103/0974-9233.159750.

Als, H. (1986). A synactive model of neonatal behavioral organization: Framework for the assessment of neurobehavioral development in the premature infant and for support of infants and parents in the neonatal intensive care environment. *Physical & Occupational Therapy in Pediatrics*, *6*, 3–55. https://doi.org/10.1080/J006v06n03_02.

Altimier, L., & Phillips, R. (2016). The neonatal integrative developmental care model: Advanced clinical applications of the seven core measures for neuroprotective family-centered developmental care. *Newborn & Infant Nursıng Revıews*, *16*, 230–244. https://doi.org/10.1053/j.nainr.2016.09.030.

American Academy of Pediatrics, & Fetus and Newborn Committee (2006). Prevention and management of pain in the neonate: An update. *Pediatrics*, *118*(5), 2231–2241. https://doi.org/10.1136/archdischild-2016-311066.

American Academy of Pediatrics Section on Ophthalmology, American Academy of Ophthalmology, American Association for Pediatric Ophthalmology and Strabismus and American Association of Certified Orthoptists. Screening examination of premature infants of retinopathy of prematurity. (2013). Pediatrics, 131, 189–195. doi: 10.1542/peds.2012-2996 Retrieved from: www.pediatrics.org/cgi/doi/10.1542/peds.2012-2996

Arnesen, L., Duran, P., Silva, J., & Brumana, L. A. (2016). Multi-country, cross-sectional observational study of retinopathy of prematurıty in Latin America and Caribbean. *Revista Panamericana de Salud Pública*, *39*, 322–329 Retrieved from https://scielosp.org/pdf/rpsp/2016.v39n6/322-329/en.

Bas, A. Y., Demirel, N., Koc, E., Ulubas Isik, D., Hirfanoğlu, İ. M., Tunc, T., & TR-ROP Study Group (2018). Incidence, risk factors and severity of retinopathy of prematurity in Turkey (TR-ROP study): A prospective, multicentre study in 69 neonatal intensive care units. *British Journal of Ophthalmology*, *0*, 1–6. https://doi.org/10.1136/bjophthalmol-2017-311789.

Bas, A. Y., Koç, E., Dilmen, U., & ROP Neonatal Study Grup (2015). Incidence and severity of retinopathy of prematurıty in Turkey. *British Journal of Ophthalmology*, *99*, 1311–1314. https://doi.org/10.1136/bjophthalmol-2014-306286.

Boyle, E. M., Freer, Y., Khan-Orakzahi, Z., Watkinson, M., Wright, E., Ainsworth, J. R., & McIntosh, N. (2006). Sucrose and non-nutritive sucking for the relief of pain in screening for retinopathy of prematurıty: A randomised controlled trial. *Archives of Disease in Childhood. Fetal and Neonatal Edition*, *91*, F166–F168. https://doi.org/10.1136/adc.2005.087668.

Cicchetti, D. V. (1994). Guidelines, criteria, and rules of thumb for evaluating normed and standardized assessment instruments in psychology. *Psychological Assessment*, *6*(4), 284–290. https://doi.org/10.1037/1040-3590.6.4.284.

Cogen, M. S., Parker, J. S., Sleep, T. E., Elsas, F. J., Metz, T. H., & McGwin, G. (2011). Masked trial of topical anesthesia for retinopathy of prematurıty eye examinations. *Journal of AAPOS*, *15*(1), 45–48. https://doi.org/10.1016/j.jaapos.2010.11.011.

Da Costa, M. C., Eckert, G. U., Fortes, B. G. B., Filho, J. B. F., Silveira, R. C., & Procianoy, R. S. (2013). Oral glucose for pain relief during examination for retinopathy of prematurity: A masked randomized clinical trial. *Clinics*, *68*(2), 199–203. https://doi.org/10.6061/clinics/2013(02)OA13.

Darlow, B. A., Gilbert, C. E., & Quiroga, A. M. (2013). Setting up and improving retinopathy of prematurıty programs interaction of neonatology, nursing and ophthalmology. *Clin Perinatol*, *40*, 215–227. https://doi.org/10.1016/j.clp.2013.02.006.

Dilli, D., İlarslan, N. E., Kabataş, E. U., Zenciroğlu, A., Şimşek, Y., & Okumuş, N. (2014). Oral sucrose and non-nutrıtıve sucking goes some way to reducing pain during retinopathy of prematurıty eye examinations. *Acta Paediatr*, *103*(2), e76–e79. https://doi.org/10.1111/apa.12454.

Francis, K. (2016). What is the best practice for providing pain relief during retinopathy of prematurıty eye examinations? *Advances in Neonatal Care*, *16*(3), 220–228. https://doi.org/10.1097/ANC.0000000000000267 Retrieved from: https://insights.ovid.com/pubmed?pmid=27195471.

Gibbins, S., Stevens, B., Yamada, J., Dionne, K., Campbell-Yeo, M., Lee, G., & Taddio, A. (2014). Validation of premature ınfant pain profile-revised (PIPP-R). *Early Human Development*, *90*(4), 189–193. https://doi.org/10.1016/j.earlhumdev.2014.01.005.

Hellström, A., Smith, L. E. H., & Dammann, O. (2013). Retinopathy of prematurity. *Lancet*, *382*(9902), 1445–1457. https://doi.org/10.1016/S0140-6736(13)60178-6.

Hwang, J. H., Lee, E. H., & Kim, E. A. (2015). Retinopathy of prematurıty in very-low-birth-weight infants in Korea: Incidence, treatment and risk factors. *Journal of Korean Medical Science*, *30*, 88–94. https://doi.org/10.3346/jkms.2015.30.S1.S88.

Kandasamay, Y., Smith, R., Wright, I. M. R., & Hartley, O. (2011). Pain relief of premature infants during ophthalmology assessment. *Journal of AAPOS*, *15*, 276–280. https://doi.org/10.1016/j.jaapos.2011.03.009.

King, C., & Norton, D. (2017). Does therapeutic positioning of preterm infants impact upon optimal health outcomes? A literature review. *Journal of Neonatal Nursıng*, *23*, 218–222. https://doi.org/10.1016/j.jnn.2017.03.004.

Kleberg, A., Warren, I., Norman, E., Mörelius, E., Berg, A., Mat-Ali, E., et al. (2008). Lower stress responses after Newborn Individualized Developmental Care and Assessment Program care during eye screening examinations for retinopathy of prematurity: A randomized study. *Pediatrics*, *121*(5), e1267–e1278. https://doi.org/10.1542/peds.2006-2510 Retrieved from: http://pediatrics.aappublications.org/content/121/5/e1267.long.

Liu, Q., Yin, Z. Q., Ke, N., Chen, X. K., Chen, L., Fang, J., ... Pi, L. H. (2014). Incidence of retinopathy of prematurity in Southwestern China and analysis of risk factors. *Medical Science Monitor: International Medical Journal of Experimental and Clinical Research*, *20*, 1442–1451. https://doi.org/10.12659/MSM.890688.

Mandel, R., Ali, N., Chen, J., Galic, I. J., & Levesque, L. (2012). Nitrous oxide analgesia during retinopathy screening: A randomised controlled trial. *Archives of Disease in Childhood. Fetal and Neonatal Edition*, *97*, F83–F87. https://doi.org/10.1136/adc.2011.210740.

Mitchell, A., Stevens, B., Mungan, N., Johnson, W., Lobert, S., & Boss, B. (2004). Analgesic effects of oral sucrose and pacifier during eye examinations for retinopathy of prematurity. *Pain Management Nursing*, *5*(4), 160–168. https://doi.org/10.1016/j.pmn.2004.06.001.

Mitchell, A. J., Green, A., Jeffs, D. A., & Roberson, P. K. (2011). Physiologic effects of retinopathy of prematurity screening examinations. *Advances in Neonatal Care: Official Journal of the National Association of Neonatal Nurses*, *11*(4), 291–297. https://doi.org/10.1097/ANC.0b013e318225a332.

Noordzij, M., Dekker, F. W., Zoccali, C., & Jager, K. J. (2011). Sample size calculations. *Nephron. Clinical Practice*, *118*, c319–c323. https://doi.org/10.1159/000322830.

O'Dwyer, P.A. (Çev. Ed.) Pediatrik Retina Hastalıkları El Kitabı. Wright, K.W., Spiegel, P.H. ve Thampson, L.S. (Ed). Prematüre Retinopatisi., 2011, 285–349, Nobel Tıp Kitabevi, Özyurt Matbaacılık, Adana.

O'Sullivan, A., O'Connor, M., Brosnahan, D., McCreery, K., & Dempsey, E. M. (2010). Sweeten, soother and swaddle for retinopathy of prematurıty screening: A randomised placebo controlled trial. *Archives of Disease in Childhood. Fetal and Neonatal Edition*, *95*(6), F419–F422. https://doi.org/10.1136/adc.2009.180943.

Padhi, T. R., Sareen, D., Pradhan, L., Jalali, S., Sutar, S., Das, T., ... Behera, U. C. (2015). Evaluation of retinopathy of prematurity screening in reverse Kangaroo Mother Care: A pilot study. *Eye*, *29*(4), 505–508. https://doi.org/10.1038/eye.2014.340.

Ribeiro, L. M., Castral, T. C., Montanholi, L. L., Dare, M. F., Silva, A. C., Antonini, S. S., & Scochi, C. G. (2013). Human milk for neonatal pain relief during ophthalmoscopy. *Revista da Escola de Enfermagem da USP*, *47*(5), 1039–1045. https://doi.org/10.1590/S0080-623420130000500005.

Stevens, B. J., Gibbins, S., Yamada, J., Dionne, K., Lee, G., Johnston, C., & Taddio, A. (2014). *Premature ınfant pain profile-revised (PIPP-R) initail validation and feasibility; Clinical Journal of Pain; 30(3), 238–243 Retrieved from https://insights.ovid.com/pubmed?pmid=24503979. https://doi.org/10.1515/fhep-2013-0025.*

Stevens, B. J., Johnston, C., Patrıca, P., & Taddio, A. (1996). Premature infant pain profile: Development and initial validation. *Clinical Journal of Pain*, *12*(1), 13–22. https://doi.org/10.1097/00002508-199603000-00004.

Sun, X., Lemyre, B., Barrowman, N., & O2Connor, M. (2010). Pain managemenet during eye examinations for retinopathy of prematurıty in preterm infants: A systematic review. *Acta Pediatrica*, *99*, 329–334. https://doi.org/10.1111/j.1651-2227.2009.01612.x.

Turkish Guidelines on Retinopathy of Prematurity (2016). *Turkish Neonatology Society and the Turkish Ophthalmology Association Retrieved November 16, 2016, from website http://www.turkpediatri.com/wpcontent/uploads/2016/06/premature_retinopatisi_rehberi.pdf.*