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The effects of alternative positioning on preterm infants in the neonatal intensive care unit: A randomized clinical trial

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ABSTRACT

There is a paucity of studies that have investigated the developmental benefits of positioning in the neonatal intensive care unit. The purpose of this study was to investigate the effects of a new, alternative positioning device compared to traditional positioning methods used with preterm infants. In this randomized, blinded clinical trial, one hundred preterm infants (born ≤32 weeks gestation) from a level III neonatal intensive care unit in the United States were enrolled at birth. Participants were randomized to be positioned in the alternative positioning device or to traditional positioning methods for their length of stay in the neonatal intensive care unit. Infants were assessed using the *NICU Network Neurobehavioral Scale* between 35-40 weeks postmenstrual age. Clinical and feeding outcomes were also captured. Linear and logistic regressions were used to investigate differences in neurobehavioral outcome, feeding performance, and medical outcomes. Infants in the alternative positioning arm of the study demonstrated less asymmetry of reflex and motor responses on the *NICU Network Neurobehavioral Scale* ($p = 0.04$; adjusted mean difference = 0.90, 95% CI 0.05–1.75) than those positioned using traditional positioning methods. No other significant differences were observed. Reduction in asymmetry among preterm infants is an important benefit of alternative positioning, as symmetrical movement and responses are crucial for early development. However, it will be important to follow this sample of preterm infants to determine the effects of early positioning on neurodevelopmental outcome in childhood.

1. Introduction

Due to advances in perinatal and neonatal care, survival rates for preterm infants have increased (Field, Dorling, Manktelow, & Draper, 2008); however, the risk for neurodevelopmental impairment remains high (Bhutta, Cleves, Casey, Cradock, & Anand, 2002; Schmidhauser, Caflisch, Rousson, Bucher, & Latal, 2006). Preterm infants have an increased risk for cerebral palsy, motor problems, and cognitive delays (Aarnoudse-Moens, Smidts, Oosterlaan, Duivenvoorden,

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& Weisglas-Kuperus, 2009; Aarnoudse-Moens, Weisglas-Kuperus, van Goudoever, & Oosterlaan, 2009; de Kieviet, Piek, Aarnoudse-Moens, & Oosterlaan, 2009). These infants often exhibit neurobehavioral (self-regulation, state control, reflex development, muscle tone and movement) impairments that can be detected by term equivalent age while the infant is still hospitalized in the neonatal intensive care unit (NICU; Brown, Doyle, Bear, & Inder, 2006; Daily & Ellison, 2005; Korner, Constantinou, Singer, & Zeskind, 2001; Pineda et al., 2012). Additionally, preterm infants often experience feeding difficulties due to global neurodevelopmental impairment and problems with behavioral organization (Arvedson, Clark, Lazarus, Schooling, & Frymak, 2010; McCain, 2003). This can negatively impact sucking patterns and coordination of suck, swallow, breathe during oral feeding. Assessments for early neurobehavior and feeding have been developed for the high risk infant in the NICU, and early identification can inform the need for early therapeutic interventions.

One of the earliest neurodevelopmental interventions in the NICU is therapeutic positioning. The third trimester in the uterus, which is missed in part or whole by premature infants, promotes the ideal, flexed position when the infant is crowded by the uterine environment and experiences rapid brain growth, mediating flexion (arms and legs bent and trunk tucked forward) and midline orientation (Waitzman, 2007). Positioning in physiological flexion (flexion of the shoulders, hips, and knees, scapular protraction, and posterior pelvic tilt) is the ideal position of the newborn, as it promotes proper joint alignment and symmetry, supports neuromuscular development, and promotes self-soothing and behavioral organization (Aucott, Donohue, Atkins, & Allen, 2002). However, premature infants lack tonal responses and strength at birth, and they often assume extended (straight) positioning of the neck, back and extremities (Groot, 2000; Sweeney & Gutierrez, 2002). Extended positioning can affect acquisition of developmental motor skills, hinder self regulation (Hill, Engle, Jorgensen, Kralik, & Whitman, 2005), and may interfere with oral feeding skills. One study found that children born preterm were more likely to demonstrate extension in the trunk which interfered with sitting posture and significantly influenced mobility, promoted asymmetry, and decreased hand function at 1 year of age (Samsom & DeGroot, 2000). Goals of neonatal positioning with the preterm infant include not only promoting flexion, but also can include prevention of head flattening and external rotation of the hips and promotion of midline orientation to prevent asymmetrical posture and movement (Vergara & Bigsby, 2004). However, no research has been conducted investigating the effects of neonatal positioning on long term outcome.

NICU professionals have attempted to increase flexion of the premature infant through positioning aids (Vaivre-Douret, Ennouri, Jrad, Garrec, & Papiernik, 2004). Traditional positioning aids, such as swaddling and boundaries placed around the body, are used in the NICU to facilitate and maintain flexion and midline orientation. Swaddling is associated with improved neuromuscular development (Aucott et al., 2002; Short, Brooks-Brunn, Reeves, Yeager, & Thorpe, 1996), decreased startles, improved sleep (Gerard, Harris, & Thach, 2002), decreased stress, and improved self regulation during handling (Neu & Browne, 1997). Cloth boundaries around the infant relate to improved motor behavior and postural development (Vaivre-Douret & Golse, 2007), improved movement across midline, and decreased abrupt movements (Ferrari et al., 2007). Additionally, researchers using a traditional positioning protocol for preterm infants concluded that infants who were positioned appropriately had more variation in the velocity of movements and brought hands to midline more than infants who had not received a positioning protocol (Nakano, Kihara, Nakano, & Konishi, 2010).

In addition to use of blankets and boundaries, there are many commercially available products that are used to position preterm infants in the NICU. Commercially available positioning aids that have been used with preterm infants include, but are not limited to, the Snuggle Up (Phillips) and Bendy Bumper (Phillips), which aim to promote flexion and containment. The Sleep Sack (HALO) may also be used to aid temperature regulation and promote safe sleep practices. Currently, there is limited research on commercially available products, despite their widespread use.

Alternative positioning aids made of stretchable cotton that are designed to provide containment, while allowing the infant to move the extremities into extension followed by recoil back to flexion, have been introduced in the NICU. Although used in many NICUs across the United States and in Europe, no studies to date have examined the effects of these alternative positioning devices. However, results from a recent research survey indicated that the majority of nurses and therapists surveyed perceived that alternative positioning was the easiest type of positioning to use and the most beneficial for preterm infants (Zarem et al., 2013). The purpose of this trial was to compare the neurobehavioral and medical outcomes of preterm infants in the NICU positioned with the alternative positioning device compared to preterm infants positioned using traditional methods.

2. Materials and methods

2.1. Participants

This randomized clinical trial enrolled 100 consecutive admissions of preterm infants born $\leq$32 weeks gestational age. Infants with congenital anomaly were excluded. Infants were randomized to receive either the alternative positioning device or traditional positioning upon admission to the NICU. Following admission, but within the first week of life, parents gave informed consent to enroll their infant in the study. This investigation was approved by the Human Research Protection Office of the study site.