DEVELOPMENT MATTERS
A CLINICAL REASONING TOOL
FOR EVALUATING NICU PRODUCTS

FEATURED CATEGORY:
NEURODEVELOPMENTAL POSITIONING AIDS

INTRODUCTION AND BACKGROUND

As **NEONATAL THERAPISTS**, we bring a unique perspective to the neonatal intensive care unit (NICU) with an emphasis on neuroprotection and optimizing structural and functional outcomes. To better serve patients and colleagues, we use our collective education, experience, and perspective to provide insight into the neurodevelopmental aspects of neonatal products.

We intend to provide this valuable clinical reasoning guide at no cost to NICU staff, managers, and directors so they can efficiently review neonatal products for existing and potential developmental implications. This tool will also help foster considerations of safety, service, cost, educational support, and efficacy.

The developmental characteristics of NICU products are an essential part of the picture; A part that deserves notice, support, and further investigation.

DEFINITIONS, NEEDS, AND UNDERLYING ASSUMPTIONS

Definitions:

NEURODEVELOPMENTAL POSITIONING

- The practice of positioning infants in the NICU in a manner that supports not only the musculoskeletal and motor systems but aids and facilitates neurodevelopment.
- This developmental approach to positioning promotes physiologic function, neurobehavioral organization, growth, skin integrity, sleep, and brain development.
- Regardless of gestational age, neuroprotection is the ultimate priority during this critical period of brain development.[1]
- Optimal positioning offers an experience that is safe, supportive, and dynamic (versus static) while allowing the infant to be connected to and cared for by his/her family and caregivers.[1]

NEURODEVELOPMENTAL POSITIONING AIDS

- Commercially available products that are used to position infants in the NICU and support neurodevelopment as a whole.

Needs:

Infants born prematurely are often deprived of the uterine crowding that occurs in the third trimester. This critical period of time encourages the development of physiological flexion and supports neuromuscular development, self-soothing, and behavioral organization.[2, 3]

The uterine environment offers the developing fetus an environment of support, appropriate sensory input, containment, safety, and sleep. This environment buffers the infant from noxious stimuli while supporting flexion in an anti-gravitational world. The uterine wall provides the perfect anatomical and sensory boundary for the development of muscle tone, movement, and reflexes and supports muscles, tissues, and joints.[4]

Active extension and arching become dominant or unopposed motor patterns for preterm infants in the NICU. The forceful prenatal motor pattern of active extension as a fetus kicks and stretches in the womb is no longer counterbalanced by consistent uterine boundaries that allow a fetus to return to a flexed midline position. Extremely preterm infants at full-term age equivalency usually appear motorically different than infants born at full term; their active extension is stronger, asymmetry is common, and spontaneous movements are large excursion and poorly controlled.[3]

Inadequate positioning in the NICU forces infants to remain in flat, hyperextended, and/or asymmetric positions, which can contribute to increased stress/agitation, decreased physiologic stability, uncontrolled or frenetic motor activity and energy depletion; difficulty with caregiving; iatrogenic postural deformities, reinforcement of atypical connections in developing neural pathways, strengthening of abnormal postures and movements including arching, and altered perception/interaction within the infant's environment.[5, 6]

Neurodevelopmental positioning aids provide the premature or sick infant with optimal support that positively impacts continued growth and neurodevelopment.[2]

Underlying Assumptions:

- Birth that occurs before optimal fetal musculoskeletal and neurologic maturation places premature infants at risk for atypical motor development.[2]
- The goals and key components of neurodevelopmental positioning have evolved.
- Neurodevelopmental positioning aids must reflect this ongoing evolution and be supported by the best available literature and research.[7]
- Developmental effects of positioning are evident before NICU discharge.[3, 5]
- Effective positioning can reduce asymmetry in preterm infants.[8]
- Neurodevelopmental positioning in physiological flexion not only includes flexion of the shoulders, hips, and knees but also midline orientation, scapular protraction, and posterior pelvic tilt. This promotes proper joint alignment, symmetry and neuromuscular development to support self-soothing and behavioral organization.[4, 6]
- Relief of cranial pressure/prevention of cranial molding is inherently related to neurodevelopmental positioning and symmetry.[8]
- Movement is a necessary component of normal development.
- Movement against a dynamic boundary promotes the development of normal movement patterns and muscle tone while facilitating behavioral organization.[4]
- Concave nests formed from a blanket or blankets draped over blanket rolls frequently are too wide and shallow to provide adequate containment, flexion, and midline orientation.[6, 7]
- Sleep is vital to growth and development.[2, 9]
- Skin integrity and skin health positively contribute to the infant's overall well-being.
- In utero, preterm infant development is sequential and orderly.
- Therapeutic touch and positioning should be guided the baby's physiologic and behavioral responses.[1]
- Experience affects brain development; cells have memory.[10]
- Infants seek balance and homeostasis.[2]
- Empowering parents in the care of their infant facilitates the transition to home and positively impacts future development.[2, 10]

- Further research in this area is warranted.[5, 11]
- Infants must be provided with individualized, age-appropriate care.[1, 9]
- There is a gap between well documented neonatal research and current NICU practices.[1, 2]

CLINICAL REASONING TOOL: VITAL ASPECTS OF NEURODEVELOPMENTAL POSITIONING AIDS

The clinical reasoning tool was developed in a questionnaire format to evaluate NICU products primarily from the perspective (as best we can understand it) of the infant and his/her systems.

As part of the NICU product assessment, review EACH section within the tool and consider the impact the product has on the infant. You will notice that some features are for future considerations and do not, to our knowledge, exist yet in the market. Upon completion, you will gain tremendous insight into the developmentally supportive features each product has within this category.

NEUROBEHAVIORAL

Secure positioning promotes improved rest and neurobehavioral organization resulting in a calmer infant who is easier to care for.[5, 6] A stable motor system with appropriate and continuous adaptations to sensory stimuli will foster optimal development and neurobehavioral organization. Therefore, neurobehavioral questions are represented within the following five categories:

- Sensory
- Neuromotor
- Musculoskeletal
- Sleep
- Accessibility/Ease of Use

SENSORY

Tactile:

Sensory system development in the preterm infant is a critical period of development. The infant's tactile system is the first to develop and receptors are found in the skin as early as 8 weeks gestational age. The tactile system includes touch, temperature, pressure, proprioception and pain. The infant in the NICU experiences an overload of noxious stimuli to the skin, such as unpleasant touch or procedural touch (IV's, tubes). A concentration of sensory receptors are found in and around the nose, mouth, palms, and soles of the feet.

The skin, along with the type of touch (human, nurturing and/or procedural), play vital roles in neurodevelopmental positioning.

QUESTIONS

1. Is the aid made of comfortable material?

2. Does the integrity of the material withstand cleaning and laundering when cared for per manufacturer's guidelines?

3. Does the aid relieve pressure on boney prominences?

4. Does the aid need to be warmed or cooled to a neutral thermal environment?

5. Is the material conducive to maintaining skin integrity?

Proprioception:

The ability to sense stimuli arising within the body regarding position, motion, and equilibrium.

QUESTIONS

1. Does the aid provide opportunities for the infant to experience proprioceptive input via complete circumferential support?

2. Do the boundaries provide both passive support (at rest) and dynamic support during active movement?

Visual:

Eyelids open around 24 weeks; the visual cortex is forming at its peak at 28 weeks, and the pupillary response isn't fully intact until 36 weeks. The visual system goes on to develop after term up to 1 year of age. Caregivers must consider the adaptation of environmental lighting and protect from abnormal levels of lighting.

QUESTIONS

1. Can the aid provide protection against changes in environmental lighting?

2. Does the aid allow parents to view the infant's face?

Vestibular:

A complex sense concerned with the perception of body position and motion, mediated by end organs in the vestibular system, and stimulated by alterations in the pull of gravity and by head movements.

QUESTIONS

1. Does the product protect against noxious vestibular input/absorb shock during transport?

2. Is the aid capable of mitigating noxious vestibular input?

NEUROMOTOR

Posture, Tone, Movement, and Reflexes:

Physiological flexion is vital for the development of normal movement and control. Term infants are born with this type of flexor tone, which further provides stabilization for movement, balance, and development of muscle control. Preterm infants in the NICU lack this kind of tone at birth.

Fetal movement and postures contribute to the shape of the infant's skull, joints, and spinal curvature. When infants in the NICU are not afforded freedom of movement or are restricted, they are at risk for further deformities. Allowing the infant to experience dynamic movements versus remaining static more closely mimics the intra-uterine environment while also supporting further neuromotor development.

Caregivers in the NICU have the opportunity to positively influence posture and movement while supporting the infant's tone and reflex development.

QUESTIONS

1. Does the aid offer support to the resting and active posture of the infant in all positions?
2. Does the aid offer support for developing muscle tone by providing increased containment (or decreased) depending on the individual needs of the infant?
3. Does the aid provide adequate support while allowing movement against a dynamic as opposed to static surface or boundary?
4. Does the aid support developing reflexes such as sucking, upper and lower extremity recoil, and palmar/plantar grasp?
5. Does the aid provide circumferential support?
6. Does the aid return to its resting state after stretched/pushed against to continue to support flexion at rest? (i.e., is there recoil?)

MUSCULOSKELETAL

A birth that occurs before optimal fetal musculoskeletal maturation places the infant at risk for atypical motor development. Preterm infants are prone to flattened postures, cranial molding, head/neck asymmetry, shoulder girdle retraction, hip abduction, and overall patterns of extension. Incomplete development of bones, with altered ossification and density, creates a vulnerability to fractures. Restricted positions and prolonged joint compression can lead to further developing iatrogenic deformities such as muscle shortening or skeletal deformation.[4]

QUESTIONS

1. Can the aid support the infant's head in midline?
2. Does the aid support the shoulder girdle in protraction?
3. Does the aid support hands to midline/face/mouth?
4. Does the aid support the trunk in alignment and flexion?

5. Does the aid support appropriate hip flexion?

6. Does the aid provide appropriate pelvic tilt?

7. Does the aid support the knees and ankles in flexion and alignment?

8. Does the aid restrict the infant in any way that is not age-appropriate or neurodevelopmentally appropriate?

9. Does the aid allow joint compression while providing freedom of movement?

10. Does the aid address prevention of cranial flattening?

11. Does the aid facilitate symmetry in the musculoskeletal system?

12. Does the aid allow individualized patterns of movement of the joints?

SLEEP

Sleep is vital for growth and neurodevelopment. The average daily sleep needs for premature infants less than 37 weeks is 17-20 hrs/day.[12] Sleep in the NICU is interrupted numerous times per day due to environmental influences and practical provision of intensive care. Neurodevelopmental positioning aids can contribute to sleep by increasing comfort, decreasing motoric stress, and increasing opportunities for self-regulation.[2]

QUESTIONS

1. Does the aid promote shoulder rounding and hand to face/mouth for self-regulation?

2. Does the aid support a return to flexion if the infant is startled?

3. Does the aid shield the infant's eyes from direct bright light?

4. Does the aid support deep sleep?

ACCESSIBILITY/EASE OF USE

Infants are in constant interaction with their environment, seeking stability and homeostasis. The caregiver must be able to work within the macro and microenvironment in a safe manner that supports efficient workflow while also meeting the needs of the infant and family. The aids chosen by caregivers or institutions must be age-appropriate and support care interactions. Environmental adaptations that support brain development are the responsibility of the caregiver. (Within limits of existing physical space.)

QUESTIONS

1. Does the aid benefit a variety of ages?

2. Is the aid compatible with a variety of diagnoses?

3. Is the aid easily adjustable or adapted with the use of medical equipment? (IV, tubes, ventilators, etc.)

4. Can the aid provide individualized support during caregiving or family activities (heel stick, supporting life, development, connection and safety. intubation, x-ray, transfers, skin to skin holding)

5. Can the aid be used during transport?

6. Can the aid be used during X-ray?

7. Can the aid be used during an MRI?

8. Does the aid allow immediate access to the infant?

9. Can the aid be used during resuscitation?

10. Does the aid allow the caregiver to support the infant's upper or lower body separately during routine care and procedures? i.e., supports the upper body during diaper change thereby supporting neurobehavioral organization via motor support

11. Is the aid intended for single patient use only?

12. Is the aid reusable (multi-patient use)?

SUMMARY

Non-separation or connecting the infant to the family is the ultimate goal. Yet how can we best achieve this in an intensive care environment? Which products facilitate connection and development while maintaining high-level performance and supporting overall health and safety?

When you evaluate products or equipment from the infant's perspective, you begin to shift your thinking. You start to think of every product as a means of supporting life, development, connection, and safety.

As neonatal therapists, we're taught from the beginning to analyze the everyday activity of our patients. We're taught to assess the positive and negative effects of the environment and how to adapt the environment to maximize development. This questionnaire takes what you know and organizes it for your consideration and use.

Hopefully, having this information at your fingertips, peer reviewed and organized, saves you time, energy, and frustration while allowing you to advocate for the babies and families in your care.

It's a whole new world.

REFERENCES

1. Browne JV, Jaeger CB, Kenner C. Executive summary: standards, competencies, and recommended best practices for infant-and family-centered developmental care in the intensive care unit. Journal of Perinatology. 2020;40(1):5-10.

2. Altimier L, Phillips R. The neonatal integrative developmental care model: advanced clinical applications of the seven core measures for neuroprotective family-centered developmental care. Newborn and Infant Nursing Reviews. 2016;16(4):230-44.

3. Madlinger-Lewis L, Reynolds L, Zarem C, Crapnell T, Inder T, Pineda R. The effects of alternative positioning on preterm infants in the neonatal intensive care unit: A randomized clinical trial. Research in Developmental Disabilities. 2014;35(2):490-7.

4. Sweeney JK, Heriza CB, Blanchard Y, Dusing SC. Neonatal physical therapy. Part II: Practice frameworks and evidence-based practice guidelines. Pediatric Physical Therapy. 2010;22(1):2-16.

5. King C, Norton D. Does therapeutic positioning of preterm infants impact upon optimal health outcomes? A literature review. Journal of Neonatal Nursing. 2017;23(5):218-22.

6. Hunter J. Therapeutic positioning: neuromotor, physiologic, and sleep implications. Developmental Care of Newborns and Infants (2e éd). 2010:285-312.

7. Browne JV, PCNS-BC IV I. Report of the first consensus conference on standards, competencies and recommended best practices for infant and family centered developmental care in the intensive care unit. 2019:1-139.

8. Yang W, Chen J, Shen W, Wang C, Wu Z, Chang Q, et al. Prevalence of positional skull deformities in 530 premature infants with a corrected age of up to 6 months: A multicenter study. BMC Pediatrics. 2019;19(1):1-9.

9. Griffiths N, Spence K, Loughran-Fowlds A, Westrup B. Individualised developmental care for babies and parents in the NICU: Evidence-based best practice guideline recommendations. Early Human Development. 2019;139:104840.

10. Spittle A, Treyvaud K, editors. The role of early developmental intervention to influence neurobehavioral outcomes of children born preterm. Seminars in Perinatology; 2016: Elsevier.

11. Fletcher L, Pham T, Bar S, Li D, Spinazzola R, Papaioannou H, et al. Variation in neonate swaddling techniques. Advances in Neonatal Care. 2018;18(4):302-6.

12. Coughlin ME. Transformative nursing in the NICU: Trauma-informed age-appropriate care. 2014.