

**EFFECTS OF PRONE VERSUS SUPINE POSITIONING IN PRETERM INFANTS: SLEEP, RESPIRATORY, AND DEVELOPMENTAL CONSIDERATIONS—A NARRATIVE REVIEW****Dr. Hemant Nandgaonkar**

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ABSTRACT Positioning is an important component of neonatal care and may influence sleep, respiratory function, arousal, oxygenation, and postural organization in preterm infants. Prone positioning is frequently used during monitored neonatal intensive care, whereas supine positioning is recommended for routine sleep. This narrative review synthesizes evidence comparing prone and supine positioning in preterm infants, with emphasis on sleep, arousal, apnea, respiratory function, oxygenation, postural organization, cranial shape, and developmental care. Prone positioning may improve sleep duration and efficiency and may provide selected short-term respiratory benefits in appropriately monitored infants; however, findings regarding apnea are mixed. Cerebral oxygenation responses are heterogeneous and may be influenced by head position and clinical status. Developmentally supportive positioning may facilitate flexion, midline orientation, symmetry, comfort, sleep protection, and pressure redistribution. Positioning should therefore be individualized according to medical stability, respiratory support, developmental needs, tolerance, and monitoring requirements. Therapeutic positioning in the neonatal intensive care unit should be clearly distinguished from routine unattended sleep after discharge.

KEYWORDS : Preterm Infant; Prone Positioning; Supine Positioning; Neonatal Intensive Care; Developmental Care; Occupational Therapy

INTRODUCTION

Preterm infants have immature respiratory, autonomic, sensory, and motor systems and may respond differently to changes in body position. Positioning is therefore an important component of neonatal intensive care because it can influence respiratory function, sleep organization, arousal, oxygenation, and postural alignment (Bhat et al., 2006; Skelton et al., 2023).

Prone positioning has traditionally been used during monitored neonatal care because it may improve sleep organization and selected respiratory outcomes in preterm infants (Bhat et al., 2006). In contrast, supine positioning is recommended for routine infant sleep because it is associated with a lower risk of sleep-related infant death (Moon et al., 2022). The physiological response to positioning may vary according to gestational age, postnatal age, respiratory support, sleep state, head orientation, and medical stability.

Developmentally supportive positioning extends beyond selecting a single body position. It includes flexion, midline orientation, symmetry, containment, comfort, pressure redistribution, and recognition of infant behavioural cues. Such positioning strategies may support motor organization and sleep patterns in preterm infants, although the available evidence remains heterogeneous (Carneiro et al., 2024).

This narrative review examines evidence concerning prone and supine positioning in preterm infants, focusing on sleep and arousal, apnea and respiratory function, oxygenation, postural development, cranial shape, and implications for neonatal occupational therapy.

Review Method

A narrative literature review was undertaken using relevant primary studies, randomized controlled trials, systematic reviews, meta-analyses, and clinical recommendations addressing positioning of preterm infants. Evidence was considered across sleep and arousal, apnea and respiratory function, systemic and cerebral oxygenation, physiological stability, postural organization, cranial deformation, and developmental care.

Because the literature varies substantially in gestational age, postnatal age, clinical condition, respiratory support, duration of positioning, sleep state, head orientation, and outcome measures, findings were synthesized narratively rather than quantitatively pooled. Greater emphasis was placed on systematic reviews, randomized trials, and relevant neonatal studies.

Sleep and Arousal

Prone positioning has been associated with changes in sleep

organization in preterm infants. In a prospective observational study of very preterm infants approaching neonatal-unit discharge, Bhat et al. (2006) found longer sleep duration and greater sleep efficiency in the prone position. Prone positioning was associated with fewer obstructive apneas but more central apneas, whereas supine positioning produced more awakenings and arousals.

Ariagno et al. (2006) reported longer intervals between successive spontaneous arousals during prone sleep at one- and three-month corrected age. These findings suggest greater sleep consolidation during prone sleep under the conditions studied. A systematic review similarly found that prone positioning generally improved sleep quality and duration in preterm infants, although evidence was limited and heterogeneous (Skelton et al., 2023).

Reduced spontaneous arousal should, however, be interpreted cautiously. Arousal is an important physiological response during sleep, and altered arousability cannot be considered independently of clinical context. Importantly, sleep-promoting effects observed during monitored neonatal care should not be interpreted as support for routine prone sleeping after discharge. Current safe-sleep guidance recommends supine positioning for every sleep (Moon et al., 2022).

Apnea and Respiratory Function

Body position can influence thoracic mechanics, diaphragmatic function, airway patency, ventilation, and pulmonary ventilation distribution. Dimitriou et al. (2021) found that diaphragmatic work of breathing was lower in the prone position than in the supine position among convalescent preterm infants breathing unsupported before neonatal discharge.

The effect of positioning on apnea is less consistent. Bhat et al. (2006) observed fewer obstructive apneas but more central apneas in the prone position. Therefore, a reduction in one type of respiratory event does not necessarily indicate improved respiratory control.

Richmond et al. (2023) conducted a randomized triple-crossover study in 68 spontaneously breathing preterm infants born before 32 weeks' gestation. Propped and prone positioning significantly reduced apnea, bradycardia, and desaturation events and improved the proportion of time within target oxygen saturation ranges compared with supine positioning.

Recent evidence provides additional context. Jain et al. (2026) conducted a randomized controlled trial in preterm neonates receiving non-invasive respiratory support. Prone positioning did not significantly reduce the duration of non-invasive ventilation; however, the study reported lower peak oxygen requirements and fewer apnea

episodes in the prone group. Thus, prone positioning may provide selected short-term respiratory benefits without reducing overall respiratory support duration.

Evidence in mechanically ventilated neonates remains limited. A Cochrane review found limited evidence of slightly improved oxygenation with prone positioning but no sustained, clinically relevant benefit of a particular body position (Rivas-Fernandez et al., 2016). Consequently, prone positioning should be considered a context-dependent supportive intervention rather than a universal or standalone treatment for apnea or respiratory dysfunction.

Oxygenation and Physiological Stability

Body and head position can influence ventilation, perfusion, venous return, blood pressure, and cerebral oxygenation. However, evidence concerning cerebral oxygenation is heterogeneous.

Fyfe et al. (2014) found that cerebral tissue oxygenation was lower in preterm infants when prone compared with supine in the conditions studied. Mean arterial pressure was also lower in the prone position at some time points, indicating that body position may influence cerebral oxygenation and hemodynamics.

Conversely, a systematic review by Jani et al. (2022) found substantial variation among studies in gestational age, postnatal age, respiratory support, and monitoring conditions. Overall, non-supine positioning did not appear to adversely affect regional or cerebral oxygenation, although the effect of head rotation remained unclear.

Maes et al. (2023) also reported heterogeneous findings regarding cerebral oxygenation and body position. Their meta-analysis found no consistent overall effect of body position on cerebral tissue oxygen saturation during the first two weeks after preterm birth, although a higher value was observed in prone positioning during a second-week subgroup analysis. These findings emphasize that cerebral oxygenation cannot be interpreted solely according to whether an infant is prone or supine.

Postural and Developmental Considerations

Preterm infants may demonstrate reduced flexor tone, immature postural control, shoulder retraction, excessive hip abduction, and difficulty maintaining midline orientation. Developmentally supportive positioning aims to facilitate flexion, symmetry, midline orientation, organized movement, comfort, and interaction with the environment.

A structured positioning approach may improve consistency of developmental care. Upadhyay et al. (2021) demonstrated improvement in developmentally supportive positioning practices following implementation of a positioning policy, staff education, audits, nesting aids, and caregiver training.

A systematic review by Carneiro et al. (2024), which included 12 studies, reported that therapeutic nest positioning may support flexor posture, midline orientation, sleep patterns, and motor development in hospitalized preterm infants. However, the included interventions and methodological quality varied, supporting individualized rather than uniform positioning practices.

Cranial shape is another important consideration. Preterm infants may experience prolonged pressure on the developing skull because of limited spontaneous movement, prolonged hospitalization, and repeated positioning. Saji et al. (2024) conducted an open-label randomized trial in infants born at ≤ 32 weeks' gestation and < 1500 g. A mustard-seed-filled pillow used with standard nesting reduced measures of deformational plagiocephaly over four weeks. However, this evidence relates to a specific intervention and should not be interpreted as justification for routine use of a particular positioning device in all infants.

Therefore, developmental positioning should be individualized according to tone, spontaneous movement, symmetry, head shape, skin integrity, medical devices, respiratory support, and behavioural tolerance.

Table 1. Summary of Evidence and Clinical Implications

Domain	Evidence summary	Clinical implication
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Sleep	Prone positioning may increase sleep duration and efficiency and reduce spontaneous arousals in some preterm infants.	May be considered during appropriately monitored NICU care when clinically indicated.
Apnea and respiration	Effects vary according to apnea type and clinical condition. Recent evidence suggests fewer respiratory events and lower oxygen requirements in selected infants, but no reduction in overall duration of respiratory support.	Use according to respiratory status and neonatal-unit protocol; not as a standalone apnea treatment.
Oxygenation	Cerebral and systemic oxygenation responses are heterogeneous and may be influenced by head position and physiological status.	Monitor oxygenation and overall physiological stability rather than assuming one position is universally superior.
Postural development	Flexion, midline orientation, symmetry, containment, and pressure redistribution are important components of developmental positioning.	Individualize nesting, head alignment, support surfaces, and positional variation.
Cranial shape	Prolonged pressure and limited positional variation may contribute to cranial asymmetry.	Assess head shape and redistribute pressure appropriately.
Safe sleep	Supine positioning is recommended for routine sleep and should be established before discharge when medically stable.	Clearly distinguish monitored therapeutic NICU positioning from unattended sleep at home.

Note: NICU = neonatal intensive care unit.

Implications for Neonatal Occupational Therapy

Occupational therapists have an important role in individualized positioning within the neonatal team. Assessment should consider gestational and postnatal age, respiratory support, physiological stability, muscle tone, behavioral state, spontaneous movement, symmetry, head shape, skin integrity, medical devices, and autonomic or behavioral stress cues.

When prone positioning is clinically indicated in the NICU, the occupational therapist can facilitate flexion, midline orientation, appropriate head positioning, containment, pressure redistribution, and comfortable alignment. Positioning should be coordinated with the neonatal team and modified according to physiological and behavioral responses.

Parent education is particularly important. Families should understand that therapeutic positioning in the NICU, under monitoring, is not the same as routine sleep positioning at home. Before discharge, medically stable infants should be transitioned to recommended supine sleep practices on a firm, flat, non-inclined sleep surface.

DISCUSSION

The evidence indicates that prone and supine positioning have different physiological and behavioural effects, but neither position is universally optimal for every preterm infant. Prone positioning may improve sleep consolidation and selected short-term respiratory outcomes in appropriately monitored infants (Bhat et al., 2006; Dimitriou et al., 2021; Jain et al., 2026). However, the effects on apnea vary by respiratory event type and clinical context.

The 2026 randomized controlled trial by Jain et al. provides contemporary evidence that prone positioning during non-invasive respiratory support may reduce peak oxygen requirements and apnea frequency without reducing the total duration of non-invasive ventilation. This supports positioning as an adjunct to respiratory management rather than as a substitute for established respiratory treatment.

Cerebral oxygenation findings are similarly heterogeneous. Differences between studies may reflect gestational and postnatal age, respiratory support, sleep state, head orientation, blood pressure, cerebral perfusion, and measurement techniques (Fyfe et al., 2014;

Jani et al., 2022; Maes et al., 2023). Consequently, positioning decisions should be based on continuous assessment of the infant rather than an assumption that either prone or supine positioning is inherently superior under all circumstances.

Developmentally supportive positioning provides a broader framework for neonatal occupational therapy. Flexion, midline orientation, symmetry, containment, comfort, organized movement, pressure redistribution, and sleep protection can be incorporated irrespective of the selected position. Positioning should allow appropriate variation and remain responsive to the infant's cues.

An important clinical distinction is the difference between therapeutic positioning in the monitored NICU environment and routine sleep after discharge. Prone positioning may be therapeutically appropriate for selected infants under appropriate monitoring; this does not contradict safe-sleep recommendations for supine positioning. The American Academy of Paediatrics recommends supine positioning for every sleep and recommends establishing supine sleep for hospitalized preterm infants when medically stable and no longer requiring a therapeutic non-supine position (Moon et al., 2022).

Limitations

This review has limitations inherent to its narrative design. A formal systematic-review methodology, protocol registration, risk-of-bias assessment, and quantitative meta-analysis were not undertaken. The included literature demonstrates heterogeneity in gestational age, postnatal age, medical condition, respiratory support, duration of positioning, sleep state, head orientation, and outcome measurement. Many studies primarily evaluated short-term physiological or behavioral outcomes, while evidence concerning long-term neurodevelopmental effects remains limited.

CONCLUSION

Prone positioning may improve sleep consolidation and provide short-term respiratory benefits in monitored preterm infants, although evidence regarding apnea remains mixed and it does not appear to reduce the duration of non-invasive respiratory support. Cerebral oxygenation responses are heterogeneous and should be interpreted in relation to the infant's physiological condition and head position.

Developmentally supportive positioning should emphasize flexion, symmetry, midline orientation, comfort, pressure redistribution, sleep protection, and recognition of infant cues. Neonatal occupational therapists can contribute through individualized assessment, positioning intervention, monitoring, sleep protection, and caregiver education. Therapeutic positioning in the NICU should remain distinguished from routine home sleep, for which medically stable infants should be transitioned to supine positioning.

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