A Seat for Premature Infants

Laura J. Stap, P. Ann Reinhart

Key Words: equipment design, positioning • infant, low birthweight • posture

Premature infants may benefit from short periods of supported sitting for position change, to facilitate the development of head control, to help with feeding and respiration, and to decrease intracranial pressure. This paper describes a seat designed for premature infants weighing 900 g to 2,000 g and made from thermoplastic material. The seats have been used with 30 infants with varying medical conditions.

Neonatal care has improved dramatically in the last 10 years with the advent of neonatal intensive care units (NICUs), refinements in neonatal and obstetric care, and the early intervention programs developed by therapists, nurses, and other professionals (Fitzhardinge & Ramsay, 1975; Hack, Fanaroff, & Merkatz, 1979). Positioning of the premature infant is an important component of the treatment plan. It may include the use of water beds, routine turning, propping with supports, and infant seats (Updike, Schmidt, Macke, Cahoon, & Miller, 1986).

In the NICU at Huntsville Hospital, many premature infants are hospitalized from 1 to 6 months. Maintaining infants in a sitting position in an infant seat for even short periods proved to be a problem because of their extremely small size. We found that infants weighing more than 2,000 g could be positioned in a commercial infant seat, whereas those weighing less than 900 g were usually not stable enough to sit upright. The staff believed that infants whose minimum gestational age was 32 weeks and who weighed 900 g to 2,000 g could benefit from short periods of supported sitting for position change because it facilitated the development of head control, made feeding easier, and helped with respiratory problems. Because no commercial infant seat was small enough to position infants in this weight category, we made custom seats from a low-temperature thermoplastic material. The seats offer a greater degree of support and stability than other positioning devices we had tried (e.g., beanbags, sandbags, hammocks, and doll infant seats).

The premature infant seat has been used at our hospital for 2 years with approximately 30 infants with varying medical conditions, including bronchopulmonary dysplasia (with or without nasal cannula O₂) and other types of respiratory distress syndromes, perinatal asphyxia, hydrocephalus, intraventricular hemorrhage, seizure disorders, esophageal chalasia, and failure to thrive. In addition to the other stated benefits, sitting in the seat appeared to heighten the infants' state of alertness during the first few minutes (Anderson, 1986). Many infants maintained this state of heightened alertness intermittently while sitting; others slept. Social interaction of staff members with the infants also increased while the infants were in the seat.

Literature Review

Bottos and Stefani (1982) noted that “the premature baby shows different motor development from the full term baby even when there is no diagnosis of abnormality” (p. 706). They theorized that because of this anomalous motor development it is difficult to diagnose the evolution of a pathological condition.
until the 4th or 5th month. Their research indicated that correct care for positioning and motor development gives infants a better opportunity to develop mature movements and decreases the chance that abnormal patterns will occur.

That the development of head control is crucial for motor development is generally accepted (Andre-Thomas, Chesni, & Saint-Anne Dargassies, 1960, Saint-Anne Dargassies, 1966; Milani-Comparetti & Gironi, 1967). Carter and Campbell (1975) found in their research of the early neuromuscular development of the premature infant that “the development of head control and neck muscle cocontraction appears to be facilitated by early experience” (p. 340). Attempts at head righting while the infant is supported in sitting became more effective with the infant’s increasing age, and the supported sitting position seemed to ease problems of respiration (Carter & Campbell).

Because infants fed in an upright position discharge liquid from their stomachs more quickly and are less likely to pass air to the duodenum than infants in other positions (Behrman, 1973), supported sitting may also be helpful with some feeding problems, including problems that occur with gavage and gravity feeding (inadequate gag reflex or residual symptoms of respiratory distress [Martin, 1979]) and congenital disturbances in esophageal motility, chalasia, or an abnormally relaxed cardiac orifice (vomiting and regurgitation).

The incidence of neurologic deficits in infants on ventilators and those with severe bronchopulmonary dysplasia is well documented. The neurodevelopmental abnormalities primarily associated with these infants include cerebral palsy, developmental delay, and blindness (Vohr, Bell, & Oh, 1982; Korones & Lancaster, 1981). In the study by Northway, Rosen, & Porter (1967) the incidence of neurologic deficits was as high as 34%, whereas other studies report an incidence of 11% to 29% (Vohr et al., Korones & Lancaster). These infants may benefit from therapeutic intervention emphasizing correct positioning for optimum motor development.

In stage IV bronchopulmonary dysplasia, oxygen is most easily administered in a croup tent. Because this method isolates the infant, some nurseries use a hooded seat. This allows the infant to sit upright while receiving supplemental oxygen that augments the infant’s labored respirations and enables him or her to observe the surroundings (Lough, Williams, & Rawson, 1979).

Visual, auditory, and tactile stimulation can easily be administered while the infant is in supported sitting and can encourage lateral and forward flexion of the head and neck (Anderson, 1986).

Emery and Peabody (1983) recommended head elevation at 30° above horizontal with the head at midline for any infant with increased intracranial pressure or at high risk for cerebral injury. Supported sitting of premature infants may assist in decreasing intracranial pressure and improving perfusion.

Materials and Equipment
The following materials are needed:
- One sheet of low-temperature thermoplastic material (18 in. X 24 in. X 1/8 in.)
- Paper for drawing the pattern
- A grease pencil for transferring the pattern onto the plastic
- Spray coolant
- Two pieces of Velcro for the straps (2 in. X 12 in.)
- One piece of 1/4 in. firm foam padding with adhesive backing for the head cushion and back pad (5 in. X 15 in.)
- Two pieces of hook Velcro for the strap attachment (2 in. X 3 in.)

The following equipment is needed:
- A hydrocollator or warming tray for heating the plastic (160 °F-180 °F)
- A heat gun for spot heating
- Heavy-duty scissors
- An ice water bath for cooling the entire seat
- A tape measure for measuring the distance between the neck fold and hip-knee flexion fold

Assembly
A pattern slightly larger than needed is drawn on paper placed under the infant who is positioned or held at the angle at which he or she will sit (see Figure 1). The pattern is transferred onto the plastic,

Figure 1
Infant Reclining on Pattern for Seat
which is heated in a hydrocollator or warming tray and cut.

**First-stage molding.** The infant is held in a 45° to 60° sitting position while the heated plastic is molded around him or her. The plastic is allowed to cool for approximately 2 minutes before forming. (Extreme care is taken to protect the infant’s skin.) The seat has two contours, the neck fold and the hip-knee flexion fold. The neck fold supports the head and neck at a 45° angle, and the hip-knee flexion fold maintains the sitting position by flexing the knees higher than the level of the hips (see Figure 2). To determine the distance between the two folds, measure the distance from C7 to the head of the femur. To form the neck fold, the upper third of the plastic is heated and the infant is placed in the seal. The plastic is held in place until it is partially cooled so that the contour of the neck fold is not lost. The infant is then removed and the seat is fixed in an ice water bath. The same procedure is followed for molding the hip-knee flexion fold. Care must be taken to heat just the lower third of the seat so that the neck fold and back position are not lost.

**Second-stage molding.** Before folding the sides of the seat for reinforcement, the areas to be folded are marked at the head of the humerus and the head of the femur. Slits are cut on both sides of the seat, then the sides are heated and folded inward. After folding, the edges are bonded with a heat gun.

**Seat support.** A triangular piece of plastic is cut for the seat support. The top of the seat support is as wide as the seat, whereas the base is twice as wide (see Figure 3). The support is bonded to the back of the seat by heating both surfaces with a heat gun and pressing the pieces together.

**Strap attachment.** The infant is placed in the seat for a final fitting before the straps are attached. The areas that need checking are the neck fold, hip-knee flexion fold, back and side positions, and seat support. Four openings 1 1/2 in. to 2 in. long are made for the straps by heating the area with a heat gun, piercing the plastic with a pair of scissors, and cutting the openings. The four openings are placed at the humeral head, at the head of the femur on the contralateral side, and in two parallel positions just distal to the patellae. The straps are attached by bonding hook Velcro to the seat with the heat gun and attaching the Velcro straps to the Velcro. One strap crosses the infant’s chest diagonally, and the other strap crosses the lower legs.

**Head cushion and back pad.** The infant is placed in the seat, and the straps are attached. The placement of the head cushion is marked by tracing around the infant’s head with the grease pencil. A circle slightly

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**Figure 2**
Position of Neck and Hip-Knee Flexion Folds

**Figure 3**
Attachment of Seat Support

**Figure 4**
Seat With Cushioning and Straps

**Figure 5**
Infant in Seat Under Radiant Warmer
smaller than the tracing is cut out of the foam padding, and the padding is attached to the seat. The head cushion can be modified in size as the infant grows longer and head circumference increases. The cushion is positioned so that it "cradles" the head and prevents the posterior fontanelle from coming in contact with the plastic (see Figure 4). The remainder of the foam padding is attached to the seat to cushion the spine.

It takes two people approximately 2 hours to fabricate the seat, and the cost of the materials is $60.

Discussion

The neonatologist, the neonatal nurse, and the therapist together decide which infants would benefit from a custom-made seat. Criteria are a stable respiration and heart rate, an absence of uncontrolled seizure disorders, and an ability to tolerate handling and position changes. Because it takes several fittings to make this seat, the infant's physiological state is carefully monitored. If the infant shows signs of fatigue, the seat can be made in several sessions. (We have not encountered this problem.) The length of time the infant is positioned in the seat is considered carefully. During the initial 15-minute time period the infant's vital signs, color, and overall tolerance to sitting are closely observed. If the infant exhibits no signs of problems, sitting time is gradually increased until it reaches 45 minutes per nursing shift.

Infants generally tolerate sitting at a 45° angle without problems. The angle is increased to 60° as the infant's medical condition improves and the postural muscles become stronger.

The infant is checked for pressure areas, particularly in the occipital and lumbosacral regions after sitting in the seat. If necessary, extra padding can be provided by placing an infant blanket in the seat.

The infant seat easily fits in an incubator. Smaller infants are positioned in the seat under the radiant warmer (see Figure 5).

At Huntsville Hospital, the cost of materials needed for making the seat is charged to the NICU as a supply. We have eight seats of varying sizes, which meet the needs of our nursery.

We saved the custom-made seats no longer needed by infants who graduated to a commercial infant seat. After a thorough cleaning these seats can be adapted for another infant's use by replacing the head and back cushions. It should be noted that the seats are not used interchangeably between infants because of risk of contamination.

Conclusion

A seat for premature infants was developed as an alternative to the side-lying and prone positions. Commercially available infant seats are not small enough for infants in the 900 g to 2,000 g weight category. The literature review suggests that supported sitting may benefit the development of head control, facilitate feeding and respiration, and decrease intracranial pressure in premature infants at high risk for cerebral injury.

A further study is needed to provide quantitative data validating the benefits of supported sitting for premature infants. Such a study should take into account the physiological state the infant is in while sitting in the premature infant seat; it should also consider the effects of supported sitting on head control, posture, feeding, respiratory problems, intracranial pressure, and awareness of the environment. Parameters need to be developed to determine how long and how often the medically stable premature infant should sit in the premature infant seat to derive the greatest possible benefit.

References


