The Effects of a Prefeeding Stimulation Program on Preterm Infants

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Key Words: infant, high risk • oral motor function • sucking behavior

Objective. This study examined the effects of stroking and a perioral and intraoral prefeeding stimulation program on healthy, growing, preterm infants in a Level II special care nursery. Only infants without cardiac, gastrointestinal, or central nervous system problems were included in the study.

Method. Two groups of nine randomly assigned, medically stable preterm infants, born between 30 weeks and 34 weeks gestation, were selected for the study. All infants were introduced to nipple feeding at approximately 34 weeks postconceptual age. The infants in the control group received a 5-min stroking protocol before feeding; the infants in the experimental group received a 5-min stroking protocol in addition to a perioral and intraoral stimulation program.

Results. Compared with the control group, the experimental group had a decreased number of gavage feedings, greater weight gain, and fewer days of hospitalization. The experimental group also had higher scores on the Revised Neonatal Oral Motor Assessment nutritive suck scale than the control group.

Conclusion. On a preliminary basis, the findings from this study establish the efficacy of occupational therapy in a Level II special care nursery for healthy, growing, preterm infants. Further, the specific treatment strategies conducted with the infants receiving the experimental procedures have also been preliminarily established as effective in enhancing the infants’ feeding skills, resulting in weight gain and decreased hospital stays as compared with their counterparts in the control group. However, our findings cannot be generalized to preterm infant populations who are at greater medical risk than the infants in our study because of the potentially hazardous effects that could result. Implications of the results for intervention programs and future research are discussed.
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experimental group (n = 7) received both perioral and intraoral forms of stimulation, whereas her control group (n = 7) received only tactile–proprioceptive stimulation. The stimulation for the experimental group consisted of touch or pressure stimulus around and in the mouth. For the control group, stimulation consisted of upper extremity range of motion. No significant results were found. The lack of differences between groups was explained by the small number of subjects in the study as well as the potentially confounding influence of the known positive effects of tactile–proprioceptive stimulation on weight gain (Powell, 1974).

Case-Smith (1988) examined the effects of perioral and intraoral stimulation as well as tactile, vestibular, and proprioceptive input on three preterm infants. She applied specific techniques to improve head righting patterns and oral motor stability. The results indicated a consistent increase in sucking rate and rhythm in two of the three infants, as measured by the revised Neonatal Oral Motor Assessment Scale (originally published by Braun and Palmer [1985/1986] and revised by Case-Smith).

Positive effects from tactile–kinesthetic programs with preterm infants have been reported regarding infant weight gains and increased time spent in awake and alert states (Clark, Cordero, Goss, & Manos, 1989; Scafidi, Field, & Schanberg, 1986; Schanberg & Field, 1987). In addition, infants in the treatment group of Schanberg and Field's study, showed more mature orientation, motor, habituation, and range of state behaviors and shorter hospital stays.

McCain (1992) studied the behavioral effects from stimulation (as opposed to sucking, fluid intake, etc.) in 20 preterm infants given 15 min before feedings over 2 days to 3 days, with each infant acting as his or her own control. Her findings indicated that nonnutritive sucking with or without rocking resulted in a greater number of optimal alert states for the infants than they had demonstrated in the preintervention phase of the study.

Other researchers, have noted the importance of minimizing extra handling of very low–birth weight premature infants (less than 1000 g), particularly those with a bronchopulmonary dysplasia condition (Als, 1986; Als et al., 1988; Vandenberk & Franck, 1990). It has been postulated that because of neurological immaturity, preterm infants are hypersensitive to sensory stimulation such as bright lights, noise, frequent handling, and painful medication interventions that may cause hemorrhages in different areas of the brain affecting oral motor function (Als, 1986). Implications from the results of studies in which tactile–kinesthetic stimulation is applied indicate that when preterm infants who are neurologically immature receive such forms of stimulation, they must be monitored for subtle stress signals, and the techniques with which they are handled must be modified as necessary (Als, 1986).

Neurological immaturity in the preterm infant is expressed by limitations in a variety of behaviors used to cope with sensory stimuli. One frequently observed effect in preterm infants in special care nurseries (delivering Level II services) and neonatal intensive care units (delivering Level III services for infants who are more medically fragile and at greater medical risk than those receiving Level II services) is the inability to achieve adequate nutrition through sucking. As a result, infants receive repeated gavage or nasogastric feedings. Non-nutritive stimulation during gavage feeding has been documented to improve the premature infant's clinical course by increasing the infant's sucking pressure and weight gain, and decreasing the infant's number of gavage tube feedings and days hospitalized (Bernbaum, Piero, Watkins, & Peckham, 1983; Field et al., 1982; Measel & Anderson, 1979). Potential oral sensory problems due to prolonged gavage feeding may be either oral hyposensitivity or hypersensitivity (Harris, 1986). Thus, pleasurable perioral and intraoral experiences that facilitate the maintenance of normal sensory interpretation are extremely important for preterm infants (Harris, 1986; Kron, 1966).

Review of the research literature has substantiated the positive effects of perioral, intraoral, and tactile–kinesthetic stimulation on the growth of preterm infants. It has also demonstrated the importance of neurobehavioral organization and environmental controls as basic factors in overall development and oral motor functioning of preterm infants. However, these studies have examined perioral stimulation, intraoral stimulation, or both in methodologically limited ways. Experimental and control groups were not used in all studies (e.g., Case-Smith, 1988), and studies that did include control groups (Scafidi et al., 1986; Schanberg & Field, 1987; Trykowski, 1978) were limited to 3-day and 10-day intervention periods, which may have limited the possibility of stronger effects. McCain (1992) did not measure actual oral motor function as a result of the study interventions. Finally, in the Burpee (1981) study, the effects of the perioral and intraoral treatment may have been masked by the positive effect of the tactile–proprioceptive stimulation on the control group.

Accordingly, the purpose of the present study was to provide more rigorous methodological control related to the healthy preterm infants' experience and maturation while studying the effects of stroking and perioral and
intraoral stimulation on these infants. The hypotheses of this study were that the infants in the experimental group, compared with the infants in the control group, would

1. participate in more nipple and partial nipple feeds during the course of their hospitalization
2. score higher on the Revised-Neonatal Oral Motor Assessment Scale (R-NOMAS) on the 3rd and 5th days of testing relative to their initial score
3. be discharged earlier from the hospital
4. demonstrate a greater average nutritive intake during the first 5 min of tested feedings on the 3rd and 5th days.

Method

Subjects

Premature infants were selected for this study from a Level I special care nursery on the basis of the following criteria: the infants (a) were born between 30 weeks and 34 weeks gestation, (b) were medically stable (e.g., stable vital signs) and placed in an isolette or open crib, (c) were 34 weeks gestation, (b) were medically stable (e.g., stable feeding only via gavage or nasogastric tube, and (d) had no history of cardiac, gastrointestinal disorders, or an identified central nervous system dysfunction. Parents of infants meeting study criteria received a letter describing the study and were asked to participate. During the 14-month period of soliciting subjects and collecting data, two sets of parents declined to participate. An additional two infants were dropped from the study after acquiring respiratory viruses that necessitated them to be taken off oral feeds. The remaining 18 infants were randomly assigned to either the experimental or control group. All the infants were an average size for their gestational age on the basis of maturity and intrauterine growth (Battaglia & Lubchenco, 1967; Lubchenco, Hansman, & Boyd, 1966) (see Table 1 for sample characteristics).

Instrument

The Neurobehavioral Preterm Infant Assessment (NPIA) (Gaebler, 1990) was used to evaluate each infant's habituation, state organization, reflex development, muscle tone, cuddliness, head control, attention and interaction skills, reaction to being uncovered and handled, and self-regulatory behaviors. The NPIA is an informal, nonstandardized assessment that takes 10 min to 15 min to administer and is scored in descriptive terms. It was modeled after the Assessment of Preterm Infant Behavior (Als, Lester, Tronick, & Brazelton, 1982).

The R-NOMAS was originally published by Braun and Palmer (1985/1986) and revised for this study as the

R-NOMAS by adding the following scoring criteria to the normal characteristics scale to further delineate the time intervals for data collection in this study: 0 = not at all, 1 = brief—10%, 2 = 11—50%, 3 = 51—100%. To the abnormal characteristics scale, we added the following scoring criteria: 1 = absent, 0 = present. The R-NOMAS was used to identify and quantify neonatal tongue and jaw behaviors during a 1-min trial of nonnutritive sucking and a 5-min trial of nutritive sucking while observing for normal and abnormal characteristics. Four scores provided the final results on the R-NOMAS on the basis of the following combination of categories: score 1—nonnutritive suck, normal characteristics; score 2—nutritive suck, normal characteristics; score 3—nonnutritive suck, abnormal characteristics; score 4—nutritive suck, abnorma

Table 1

Sample Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Experimental</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean birth weight (g)</td>
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<td>1671</td>
</tr>
<tr>
<td>Range</td>
<td>1605–2282</td>
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</tr>
<tr>
<td>Mean birth age (weeks)</td>
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<td>32.4</td>
</tr>
<tr>
<td>Range</td>
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<td>31–34</td>
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<tr>
<td>Mean weight (g)</td>
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<td>1735</td>
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<tr>
<td>Range</td>
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<td>1410–1975</td>
</tr>
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<td>Mean age (days)</td>
<td>10.44</td>
<td>16.22</td>
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<td>Range</td>
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<td>5–40</td>
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<tr>
<td>Mean postconceptual age (weeks)</td>
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</tr>
<tr>
<td>Range</td>
<td>32–36</td>
<td>33–36</td>
</tr>
<tr>
<td>Boys</td>
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<td>6</td>
</tr>
<tr>
<td>Girls</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Caucasian</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Black/Caucasian</td>
<td>9</td>
<td>8</td>
</tr>
</tbody>
</table>

Note. There were no significant differences < .10 in any of the means listed in this table.

* n = 9

1 At onset of study

Interrater reliability was established for the R-NOMAS by two physical therapists and two occupational therapists, one of whom was the first author of this study. All examiners were experienced Level II special care nursery therapists. During the training, each examiner administered and scored the R-NOMAS for one infant while the others observed and discussed the scores until consensus was reached. Additionally, because it was difficult for the observing examiners to identify all of the oral motor behaviors of an infant during testing because of the hands-on requirement for scoring, seven case studies were also included in the interrater reliability process. Exam-
Ingers were asked to read and score the R-NOMAS on the basis of the information provided in each case. The interrater reliability for the case studies was 95%. We used a weighted occurrence agreement percentage formula (House, House, & Campbell, 1981).

A nipple for premature infants (distributed by Mead Johnson) was used for all subjects when administering the R-NOMAS and during nipple feeds, unless it was determined by nursing staff members that another type or size of nipple would better facilitate feeding. Use of a pacifier was encouraged for calming and during gavage feeds to facilitate sucking (Measel & Anderson, 1979).

Nursing staff members used to following criteria to determine an infant’s advancement from gavage or nasogastric tube to nipple feeds: (a) approximately 34 weeks postconceptional age, (b) stable medical condition, (c) a weight of approximately 1500 g. (d) ability to suck as evidenced by pacifier use or sucking on fingers or gavage tube, and (e) not more than 1 cc of residual formula left in stomach from the previous feeding and a weight gain of at least 1/2 oz per day.

Procedure

The procedure was designed to fit within the usual routines of the nurses, parents, and therapists. Within 24 hr of each subject’s entrance into the study, the NPIA was administered between 30 min and 90 min before a scheduled feeding by one of four occupational or physical therapists (these were the same therapists who participated in the interrater reliability training for the R-NOMAS). On the basis of the NPIA results, environmental, handling, and positioning recommendations were discussed with parents and nursing staff members individually within 1 day of the assessment. This discussion took an average of 30 min. Recommendations were a function of the subject’s responses (i.e., heart rate, respiration, color, muscle tone changes, movement patterns) to environmental visual and auditory stimulation, touch, and imposed movement.

After the discussion of recommendations, parents and nurses received information regarding the 5-min stroking protocol. The stroking protocol was standard practice for healthy, growing, premature infants in the nursery before this research. We believed that it was unethical to discontinue this practice for the subjects in the control group and therefore continued it for all subjects in this study. However, neither parents, nurses, nor therapists introduced stroking techniques before the discussion of recommendations on the basis of the NPIA. This 15-min demonstration, with verbal instruction and practice period, also included a diagram with written instructions attached to the subjects’ isolettes (see Appendix A). Parents and nurses of the nine subjects in the experimental group received an additional 10 min of verbal instruction, demonstration, and practice, as well as a diagram with written instructions, to teach them the 2-min oral motor protocol (see Appendix B). If stress signals were observed during the administration of either protocol, parents of infants in both groups were instructed to pause until the infant relaxed and then to continue as long as negative reactions did not recur. If negative reactions did recur, parents were instructed to discontinue the protocol(s) for the specific session. Parents were encouraged to discuss all questions they had about the protocols with any of the therapists in the nursery.

After the parents received the protocol information, they were instructed to immediately begin carrying it out 3 times a day, 5 days a week, before feedings only, until their infants were nipple feeding all of their feedings for 24 consecutive hours. Parents were also instructed to feed their infants after they had administered the prefeeding protocol(s) (stroking protocol or stroking, perioral, and intraoral protocol). Parents were instructed to hold the infants in a supported, flexed position for all feedings, nipple or gavage, to facilitate active sucking (Shaker, 1990).

Nipple changes, pacifier use, or any patient-care–related issue, including decisions on beginning or continuing nipple feeds, were conducted by nurses and physicians independent of the investigators, according to usual protocol.

If the parents were unavailable to administer the prefeeding protocols, one of the nursery therapists or nurses intervened. Because of the posting of protocols on the isolettes, nurses and therapists providing the extra stimulation were aware of group assignments. Data collected by nursing staff members on their daily progress sheet kept at each infant’s bedside included (a) number and type of feeding (bottle or gavage), (b) daily weight gain taken after the first feeding after midnight, and (c) whether nursing or therapy staff members administered a prefeeding protocol. The parents were also asked to record on a checksheet at the bedside (a) the date and time of visit and (b) whether they administered a prefeeding protocol during their visit (some visits were social only and not near a feeding time).

Within 48 hr of the subject’s first nipple feed, the initial R-NOMAS was administered and then again on the following 3rd and 5th days. Any of the four therapists who participated in the interrater reliability training on the R-NOMAS administered the assessment. When subjects were able to nipple feed all their feedings for 24 consecutive hours, they were discharged from the study.
Results

Because of the small number of subjects in this study and its exploratory nature, we have chosen to report \( p \) levels up to a minimum confidence level of 90% \(( p < .10)\). We believed that this was an appropriate strategy because we could otherwise be omitting valuable information and potentially committing Type II errors (Huck, Cormier, & Bounds, 1974).

Hypothesized Data

Our first hypothesis was that subjects in the experimental group would engage in more nipple feeds during the course of the study than those in the control group. A \( t \) test was used to compare the percent of nipple or partially nipple feeds between the two groups from the time the subjects entered the study until they were nipple feeding all their feedings for 24 hr. The findings indicated that the subjects in the experimental group participated in a higher percentage of nipple-partial nipple feeds than those in the control group \(( t[16] = -2.4, p = .01; \) experimental group: \( M = 13.78 \text{ days}, SD = 2.72; \) control group: \( M = 17.67 \text{ days}, SD = 4.03)\). This measure was based on the total number of days between entrance into the study and discharge from the hospital. Hospital discharge criteria for the subjects included the ability to nipple feed all feedings, maintain body temperatures outside of the isotherm, and demonstrate continuous medical stability (e.g., stable vital signs).

For our second hypothesis, we compared for each group the four R-NOMAS scores, which were nonparametric, gathered within approximately 48 hr after the subject's first nipple feed and on the following 3rd and 5th days. Mann Whitney \( U \) tests demonstrated that the initial R-NOMAS scores revealed no significant differences between groups on any of the measures (see Table 2). The second time the R-NOMAS was administered, findings indicated that subjects in the experimental group scored higher on the normal characteristics of the nutritive suck scale than the control group \(( U = 25, p = .08)\). No other between-group differences were evident. (Initial nutritive sucking scores were higher for the experimental group, though the difference was nonsignificant.) The final between-group comparison of R-NOMAS scores resulted in higher scores for the experimental group as opposed to the control group on the normal \(( U = 19, p = .03)\) and abnormal characteristics \(( U = 26, p = .09)\) of the nutritive suck scale.

Our third hypothesis, which indicated that the subjects in the experimental group would be discharged from the hospital earlier than those in the control group, was confirmed \(( t[16] = -1.57, p = .07; \) experimental group: \( M = 11.22 \text{ days}, SD = 3.7; \) control group: \( M = 14.22 \text{ days}, SD = 4.3)\). Additionally, between-group weight gain was compared on the basis of subject weights upon entrance to the study and weights at discharge from the hospital. Data indicated that infants in the experimental group gained more weight than their counterparts \(( t[16] = 1.49, p = .07; \) experimental group: \( M = 31.56 \text{ g}, SD = 6.6; \) control group: \( M = 27.23 \text{ g}, SD = 5.7)\).

Our fourth hypothesis indicated that the infants in the experimental group would demonstrate a greater liquid intake during the first 5 min of nutritive sucking on the 3rd and 5th days of testing during the R-NOMAS

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Experimental</th>
<th>Control</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonnutritive suck, normal</td>
<td>10.17</td>
<td>8.83</td>
<td>0.29</td>
</tr>
<tr>
<td>Nonnutritive suck, abnormal</td>
<td>9.00</td>
<td>10.22</td>
<td>0.99</td>
</tr>
<tr>
<td>Nutritive suck, normal</td>
<td>10.06</td>
<td>8.94</td>
<td>0.32</td>
</tr>
<tr>
<td>Nutritive suck, abnormal</td>
<td>10.67</td>
<td>8.33</td>
<td>0.17</td>
</tr>
</tbody>
</table>

Note. R-NOMAS = Revised-Neonatal Oral Motor Assessment Scale

<table>
<thead>
<tr>
<th>Mean Group ( ^a ) Ranking</th>
<th>1(^b )</th>
<th>2(^c )</th>
<th>3(^d )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonnutritive suck, normal</td>
<td>10.17</td>
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<td>0.29</td>
</tr>
<tr>
<td>Nonnutritive suck, abnormal</td>
<td>9.00</td>
<td>10.22</td>
<td>0.99</td>
</tr>
<tr>
<td>Nutritive suck, normal</td>
<td>10.06</td>
<td>8.94</td>
<td>0.32</td>
</tr>
<tr>
<td>Nutritive suck, abnormal</td>
<td>10.67</td>
<td>8.33</td>
<td>0.17</td>
</tr>
</tbody>
</table>

\(^{a} n = 9 \) for each group
\(^{b} \) Five-min R-NOMAS
\(^{c} \) Third day R-NOMAS
\(^{d} \) Fifth day R-NOMAS

\( p \) levels are one tailed and corrected for ties

administration. A split plot factorial 2 x 2 analysis of variance (ANOVA) was conducted. (Table 3 includes the means and standard deviations for ANOVA of the R-NOMAS administration.) The between-subjects factor had two levels corresponding to the experimental and control groups. The repeated measures, or within-subjects factor, represented the two times liquid intake was measured. Our findings indicated that there was no group effect \((F[1,16] = 1.62, p = .22)\), time effect \((F[2, 32] = .74, p = .486)\), or interaction of group and time \((F[2, 32] = 1.06, p = .36)\). We were unable to use the pretest scores as a covariate in an analysis of covariance to analyze our findings because our data violated the common slope assumption sometimes referred to as assumption of homogenous regression coefficients or homogeneity of regression (Huck et al., 1974).

Additional Data

Three measures were also studied to address concerns related to potentially confounding variables in this study. Differences in between-group maturation as a function of age at the beginning of the study (days old and postconceptional age) were examined. A \(t\) test indicated that there were no between-group differences in age when the subjects entered the study, as measured by either their age in days \((t[16] = 1.34, p > .10)\); experimental group: \(M = 10.44\) days, \(SD = 9.58\); control group: \(M = 16.22\) days, \(SD = 8.63\) or their postconceptional age \((t[16] = .28, p = .39)\); experimental group: \(M = 34.3\) weeks, \(SD = 2.3\); control group: \(M = 34.1\) weeks, \(SD = .6\).

To demonstrate differences between the number of prefeeding protocols administered to each group daily, a \(t\) test was conducted. Results indicated no differences in the number of prefeeding procedures each group received \((t[16] = .36, p = .36)\); experimental group: \(M = 1.65\) times/day, \(SD = .41\); control group: \(M = 1.58\) times/day, \(SD = .40\).

Discussion

The research presented in this article has generally confirmed the hypotheses studied. It has also expanded on previous research (e.g., Burpee, 1981; Case-Smith, 1988; Leonard et al., 1980; Trykowski, 1978).

Similar to others' observations (e.g., Bernbaum et al., 1983; Field et al., 1982; Measel & Anderson, 1979; Scaffidi et al., 1986; Schanberg & Field, 1987), our findings indicate that the subjects in the experimental group, who received perioral and intraoral stimulation in conjunction with stroking before feeding, had an increased number of nipple feeds (or a decreased number of gavage feeds), greater weight gain, and fewer days of hospitalization than the subjects who received only stroking. Similar to Case-Smith’s (1988) findings, the subjects in the experimental group also demonstrated greater consistency in their nutritive sucking rate and rhythm (higher R-NOMAS scores) than their counterparts.

The increase in liquid intake that had been hypothesized for the experimental group during the first 5 min of R-NOMAS nutritive sucking did not occur. These findings are not consistent with Trykowski’s (1978) results. One explanation for the unanticipated results may be the differences between the type and administration of the prefeeding procedures included within our protocol compared with that of Trykowski. The lengthier protocol we administered (which included intraoral stimulation and stroking in addition to the perioral stimulation that Trykowski provided) may have facilitated general oral arousal, resulting in signs of readiness to suck, but diminished the immediate suck strength because of the subject’s lack of ability to organize and integrate the extra stimulation (Als, 1986; Morris & Klein, 1987). An additional factor potentially affecting the liquid intake may have been the result of the interaction of the stroking and the perioral and intraoral stimulation. It is plausible that the stroking may have overridden the effects of the oral motor procedure, causing less optimal, restless behavioral state changes and a poorer transition to oral feeding (McCain, 1992). Another explanation could be that a difference in liquid intake may have been evident if measured for 10 min or 15 min rather than 5 min. Finally, perhaps the increased weight gain seen in the subjects in the experimental group is a better reflection of sustained suck strength.

Though the experimental group demonstrated greater sucking coordination on the nutritive suck scales measured on the 3rd and 5th days of R-NOMAS testing, significant differences did not occur on the nonnutritive suck scales. The absence of differences for the experimental group on the nonnutritive scales may reflect weaknesses in the R-NOMAS in measuring subtle changes in non-

### Table 3

<table>
<thead>
<tr>
<th>Group</th>
<th>1 (M(SD))</th>
<th>2 (M(SD))</th>
<th>3 (M(SD))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>14.00 (9.57)</td>
<td>16.22 (6.16)</td>
<td>15.78 (5.89)</td>
</tr>
<tr>
<td>Control</td>
<td>12.00 (6.40)</td>
<td>9.89 (7.06)</td>
<td>14.00 (6.87)</td>
</tr>
</tbody>
</table>

Note: R-NOMAS = Revised-Neonatal Oral Motor Assessment Scale 
*\(n = 9\)*/
nutritive suck. For example, the lack of change seen on the nonnutritive scale may be due to the short trial for nonnutritive (1 min) versus nutritive sucking (5 min). It may be that the trial needs to be lengthened and the sensitivity improved to reflect subject behavioral change. Another factor that may have affected the nonnutritive suck scores could have been the age of the subjects. When the subjects began nippleling, their average postconceptional age was approximately 34.5 weeks. Brake, Fifer, and Alfasl (1988) suggested that around this time, infants have developmentally matured to become more efficient feeders. The treatment effects may have enhanced the maturation process for the infants in the experimental group, resulting in their heightened motivation to suck more nutritively than nonnutritionally. A related reason for a lack of nonnutritive suck difference between the two groups could be that the nonnutritive suck emerges at an earlier age than the nutritive suck. If so, the subjects may have had an efficiently established and mature nonnutritive suck at the time the oral feeds began, precluding them from an effect of the intervention process on this measure.

Other factors may have generally contributed to the limited effects seen in the results as measured by the R-NOMAS. First, a small number of prefeeding procedures occurred in each group per day (experimental group: M = 1.65 prefeeding procedures/day; control group: M = 1.58 prefeeding procedures/day), which may have decreased the effect of the intervention. We had anticipated that each subject would receive three prefeeding procedures a day, 5 days a week. However, because of the parents', nurses', and therapists' conflicting schedules, this did not occur.

The limited specificity of the scoring system (0 = not at all; 1 = brief—10%; 2 = 11—50%; 3 = 51—100%) may not have demonstrated a valid reflection of the subjects' capabilities. We attempted to make the R-NOMAS more sensitive by adding and objectifying the scoring criteria, yet even with this addition, it may have lacked the sensitivity to clearly identify the subtle sucking differences this study hoped to measure. Researchers may want to attempt to increase the sensitivity of the scoring criteria of the R-NOMAS by measuring the frequency of sucking skills on a 0—4 scale for 8 min or more, rather than 5 min, to easily break down the criteria by 2-min observations (0 = none, 1 = brief—2 min, 2 = 2.1—4 min, 3 = 4.1—6 min, 4 = 6.1—8 min).

A variety of factors such as heart rate, hunger status, and breathing patterns of infants are known to affect sucking abilities (Kron, Ipsen, & Goddard, 1973) and therefore could potentially affect R-NOMAS scores. As Case-Smith (1988) suggested, perhaps such factors affect sucking behaviors to the extent that sucking skills are not an accurate or reliable outcome measure of stroking or oral motor intervention techniques.

A unique feature of this study incorporated parent participation. The emerging standard of family-centered developmental care in special care nurseries advocates family inclusion in infant care. Though we did not measure any type of parent behavior, we believe that the potential benefits of parent involvement, both to the infant and to the parents, call for such measurement in future research. As Gilkerson, Gorski, and Panitz (1989) had indicated, optimal developmental outcomes for preterm infants and their families require close coordination between the hospital and parents. Nevertheless, the parents' involvement in this study may have negatively affected the continuity of treatment because they were not consistently available for all feedings.

**Implications for Occupational Therapy**

The positive impact of stroking and perioral and intraoral stimulation on healthy, growing, preterm infants demonstrated in this study are preliminary in nature. Our findings elucidate the need to include a comprehensive methodology in future oral motor intervention studies to specifically identify intervention effects and to confirm that our findings can be replicated with and generalized to other groups of healthy, preterm infants. Future research should therefore include a larger number of subjects to allow for a more conservative level of confidence without putting the findings at risk for Type II errors. Additional modifications in future research should incorporate the following:

- Evaluators who are not aware of group assignments, ensuring bias-free reviews of the subjects
- Four groups of infants (no stimulation, stroking only, stroking and perioral and intraoral stimulation, perioral and intraoral stimulation only), enabling one to delineate main and interactive effects of the interventions
- Refined instruments sensitive enough to measure subtle oral motor change
- Total control of the administration of the protocols to maximize intervention effects
- The measurement of parents' perceptions of empowerment as a result of their participation in an oral motor intervention training program for their infants.

Research is also necessary to explore how the methods used in this study would compare with, enhance, or
both other innovative and standard approaches used in the special care nursery. Skin-on-skin contact (e.g., Kangaroo Care [Luddington, 1990]) and measurement of subtle behavioral cues (e.g., facial grimaces, color changes) during oral motor or other types of stimulation (e.g., rocking, nonnutritive sucking) that appear to affect behavioral states during feeding (McCain, 1992) should be evaluated to develop holistic and maximally effective intervention for healthy, growing, preterm infants.

Implications of this study related to occupational therapy treatment are also preliminary and apply only to infants who meet the criteria of this study. Further, interventions should be individualized on the basis of each infant's response to treatment, with a focus on the avoidance of overstimulation. Nevertheless, our results indicate that occupational therapists working with healthy, growing, preterm infants in special care nurseries can safely incorporate stroking, perioral, and intraoral intervention techniques to potentially enhance the infants' oral motor skills and increase their chances of shortened hospital stays. Because the changing health care system demands a decrease in days of hospitalization and bottom-line costs per patient, stroking and perioral and intraoral stimulation appear to pose a preliminary approach to decreasing hospitalization costs for this population.

To maximize the effects of the intervention, the intervention strategies must be consistently carried out. Consequently, it may be necessary for occupational therapists to develop training programs for special care nursery personnel to assist in the provision of stroking and perioral and intraoral stimulation before feedings. Additionally, on the basis of a combination of our findings (e.g., weight gain, fewer days of hospitalization) and others' (e.g., increased self-esteem, empowerment as a result of parent training [Gilkerson et al., 1989]), it appears that the benefits of such intervention to the infants and their families may also warrant a parent training program coordinated with that of the special care nursery personnel.

The use of the interventions discussed in this research are not applicable to populations that include (a) unhealthy, Level II or (b) Level III infants. Infants in these two groups are more fragile and at greater medical risk than healthy, growing, preterm infants in Level II nurseries. Accordingly, potentially hazardous effects such as hemorrhages in different areas of the brain (Als, 1986) could result from the stroking, perioral, and intraoral interventions when they are used with inappropriate groups of preterm infants. ▲

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Appendix A

Stroking Protocol

The infant remains in the isolette for the duration of the entire stroking protocol. Begin 5 min before scheduled feeding. Watch for stress behaviors as described on handout by and therapist.

1. Lie infant on belly; unwrap infant if in blanket but do not undress.
2. Stroke these areas for approximately 1 min each with firm, but gentle, pressure of the hands:
   (a) Back of head
   (b) Across neck and shoulders
   (c) Down head
   3. Turn infant onto back and continue:
      (a) Down legs
      (b) Down arms—shoulders to hands
   The infant is then given routine nursing care that usually consists of a diaper change and temperature measurement before his or her upcoming feeding.

Appendix B

Oral Motor Stimulation Protocol

The oral motor protocol takes place outside the isolette if the infant is to be held for the feeding; otherwise, it occurs inside the isolette. The infant's oral area is stimulated by a three-part series consisting of the following:

1. (a) Five small, firm rubs on each side of the mouth (from the ear to the corner of the mouth)
   (b) Gentle pressure under the base of the tongue, under the chin
   (c) Repeat (a) and (b) two more times
2. (a) Five small, firm rubs around the mouth
   (b) Gentle pressure under the base of the tongue
   (c) Repeat (a) and (b), two more times
3. (a) Rub three times on upper gums, front to back on each side, gentle pressure under chin after each side is stimulated
   (b) Repeat (a) on lower gums
   (c) Repeat (a) or (b) on inside of upper gums
   (d) Rub three times back to front along upper palate
   (e) Hold small finger against upper palate for a few seconds

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