A randomized study of the efficacy of sensory-motor-oral stimulation and non-nutritive sucking in very low birthweight infant☆

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Abstract

To assess if sensory-motor-oral stimulation and non-nutritive sucking gavage feeding enhances the oral feeding performance of preterm infants born between 26 and 32 weeks of gestational age.

Study design: Very low birthweight infants (n=98) were randomized into a experimental and control group. Preterm infants in the experimental group received sensory-motor-oral stimulation and non-nutritive sucking and infants in the control group received a sham stimulation program. Both were administered from when they reached enteral diet (100 kcal/kg/day) until the beginning of oral diet. Primary outcome was length of hospital stay.

Results: Independent oral feeding was attained significantly earlier in the experimental group than the control group, 38 ±16 days of life (mean ± S.D.) versus 47± 17 days of life, respectively (P<0.001). There was significant difference in length of hospital stay between the two groups (41.9 ±17 (mean ± S.D.) versus 52.3 ±19 days (P<0.01)).

Conclusion: Sensory-motor-oral stimulation, together with early non-nutritive sucking (as soon as the newborn reaches full diet and is clinically stable) in very low birthweight preterm infants, as long as they are clinically stable, in this study, earlier initiation of oral feeding and earlier hospital discharge.

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KEYWORDS
Non-nutritive sucking; Preterm infants

☆ This study was approved by the Fernandes Figueiras Institutional Review Board/Research Ethics Committee and by neonatal unit where the research was conducted. Prior informed consent was obtained from parents/guardians of the newborns for their participation in the study.

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Preterm newborns currently have access to technology that allows survival at increasingly younger gestational ages with issues pertaining to nutrition and growth assuming great importance. The best way for newborns to feed is by sucking; however, the maturation of sucking skills of preterm infant is not completed until 32–34 weeks. Their ability to feed depends upon a coordinated sucking, swallowing and breathing pattern [1].

Before this gestational age, chances for sucking are limited in preterm infants and they are fed by gavage tube, so non-nutritive sucking has been studied as a way of providing opportunities for the preterm infants to learn the sucking needed for successful oral feeding, as well as to promote physiological stability [2–7].

Theoretically, stimulation can be beneficial for improving the newborn’s later performance in nutritive sucking, increasing the prevalence of successful breastfeeding after hospital discharge and decreasing both time-of-stay and therefore hospital and social costs. Although meta-analyses have demonstrated that, based on the current evidence, the topic non-nutritive sucking would appear to have clinical benefits, the use of sensory-motor-oral stimulation and non-nutritive sucking is has not been fully explored [8,9].

The objective of this study is to determine whether sensory-motor-oral stimulation and non-nutritive sucking in preterm newborns influence weight gain, length of stay, number of days until initiating oral feeding and number of days until reaching complete oral feeding.

### 1. Methodology

A double-blind, randomized, clinical trial was performed. The sample size was calculated considering a 20% reduction in length of stay, statistical power of 80% two-tailed type 1 error of 0.05. Randomization was stratified based on gestational age ranges (26–28, 28.1–30, 30.1–32). A total of 98 newborns were admitted to the study, from the neonatal intensive care unit at the Fernandes Figueira Institute, FIOCRUZ, Rio de Janeiro, Brazil. These preterm infants met the following inclusion criteria: birthweight <1500 g (very low birthweight), gestational age from 26 to 32 complete weeks as determined by date of last menstruation and first-trimester ultrasound or by the New Ballard scale [10], appropriate or small for gestational age according to Alexander et al. [11], and newborns who did not present congenital anomalies or severe asphyxia (as defined by 5-min Apgar score <5 or convulsions in the first 24 h). The newborns were randomized when they reached a full enteral diet (100 kcal/kg/day). The study excluded newborns that presented intraventricular hemorrhage grade III or IV documented by ultrasound, sepsis or necrotizing enterocolitis at the time of the enrollment in the study. Primary outcome was length of stay.

Newborns in the experimental group were stimulated according to both the stimulation program proposed by Fucile, Gisel and Lau [12] as well as non-nutritive sucking. The stimulation and non-nutritive sucking were not offered at any other time, and the procedures were performed by three speech therapists using a previously standardized method. The procedures were performed for 15 min, until the newborn began exclusively oral diet, at least for 10 days. The control group received the gavage tube diet with a sham procedure, also for 15 min. All preterm infants were monitored continuously before, during and after procedures using a cardiorespiratory monitor and pulse oximeter.

In both groups, the change from gavage tube to oral feeding began when the newborn reached a gestational age of at least 34 weeks was clinically stable and based on the speech therapists evaluation regardless of weight. Clinical evaluation of the newborn’s capacity to begin oral diet was performed by an external experienced speech therapist blinded which group the child belonged, three times a day.

Weight was measured daily using a Filizola scale sensitive to 5 g. Staff members who measured the newborns ‘weight were unaware of the newborns’ group status. Length of stay was counted from day of birth. The researchers had no influence on the newborn’s hospital discharge date.

The number of days until initiating independent oral feeding and the number of days until reaching complete oral feeding (feeding by oral route only) were counted from day of birth with researchers having no influence on the attending physician’s decision. The beginning and progression of oral feeding occurred according to the unit’s written routine and was the same for the two groups. When the newborn was clinically stable and presented with bowel sounds, feeding began and progression was based on acceptance of 20 ml/kg/day.

Statistical analysis of the data used the EPI-Info package (6.04) from the Centers for Disease Control, Atlanta, USA. The data were analyzed for treatment group differences with chi-square or Fisher’s exact tests for the categorical

### Table 1 Neonatal characteristics

<table>
<thead>
<tr>
<th></th>
<th>Experimental, (n=49)</th>
<th>Control, (n=49)</th>
<th>(P) value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gestational age at birth (weeks)</td>
<td>30.5 ± 1.7</td>
<td>30.2 ± 1.8</td>
<td>0.13</td>
</tr>
<tr>
<td>Birthweight (g)</td>
<td>1195 ± 221</td>
<td>1125 ± 221</td>
<td>0.12</td>
</tr>
<tr>
<td>Lowest weight reached (g)</td>
<td>1063 ± 214</td>
<td>998 ± 208</td>
<td>0.13</td>
</tr>
<tr>
<td>Days of life to recover birthweight</td>
<td>12.1 ± 5.3</td>
<td>13.2 ± 5.5</td>
<td>0.39b</td>
</tr>
<tr>
<td>Apgar score 5 min &gt;7</td>
<td>7</td>
<td>9</td>
<td>0.58</td>
</tr>
<tr>
<td>Weight upon reaching 100 ml/kg/dia (g)</td>
<td>1175 ± 218</td>
<td>1101 ± 212</td>
<td>0.09b</td>
</tr>
<tr>
<td>Days of life upon reaching 100 ml/kg/dia</td>
<td>10.4 ± 3.3</td>
<td>11.9 ± 5.6</td>
<td>0.31b</td>
</tr>
<tr>
<td>Gestational age upon reaching 100 ml/kg/dia (weeks)</td>
<td>32.2 ± 1.5</td>
<td>31.3 ± 2.1</td>
<td>0.09b</td>
</tr>
</tbody>
</table>

\(^{a}\) Plus-minus values are means ± S.D.

\(^{b}\) \(P\) value (Wilcoxon rank-sum test).

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2. Results

Of the 241 very low birthweight infants who were screened for enrollment, 103 (42%) were ineligible (40% succumbing to death; 22% presented with congenital malformations such as esophageal atresia, gastrochisis, omphalocele or another genetic problems; 10% the parents refused or were unavailable; others presented with asphyxia or convulsions). Among the remaining 138 infants, we studied 98. The remaining 40 eligible infants were not enrolled because of sepsis, intraventricular haemorrhage degree III or IV, necrotizing enterocolitis or because they were transferred for the other units before the criteria for enrollment was established.

We studied a total of 98 very low birth infants, 49 in the experimental group and 49 in the control group. Mean gestational age at birth was 30.5±1.7 weeks in the experimental group and 30.2±1.8 weeks in the control group. Preterm infants in the experimental and control groups did not differ statistically (P>0.05) in terms of: birthweight, gestational age at birth, 1- and 5-min Apgar scores; lowest weight reached; days of life to recover birthweight, weight, days of life and gestational age upon reaching 100 ml/kg/day, or duration of orotracheal intubation (in hours) (Table 1).

In relation to the beginning of sucking, on average the experimental group was able to begin the oral diet 8.2 days earlier, suspended the use of gavage tube 8.6 days earlier and was discharged from the hospital 10.4 days earlier. These differences were statistically significant. Gestational age at the beginning of sucking was not different between the two groups; however, at discharge, the experimental group presented with significantly lower gestational ages (P<0.05).

The experimental group did not differ statistically from the control group in terms of weight at discharge or weekly weight gain. However, the newborns in the experimental group were able to initiate sucking at a lower weight than the control group and went faster to full oral feeding (Table 2).

There was no difference in sucking frequency/day between groups. All these babies were feeding every 2 h.

3. Discussion

Preterm infants present with significant difficulties during the post-natal period, such as infections, respiratory problems, hypoglycemia, asphyxia and others. In addition, nutritional issues are a major challenge, especially considering nutritional requirements to maintain vital capacity, the growth and development of these infants. The nutritional challenges include the difficulty newborns less than 34 weeks of gestational age have in coordinating sucking, breathing and swallowing. Preterm newborns are known to present with an increased risk of feeding difficulties due to prolonged hospitalization [13,14] and limited opportunities for sucking [12], thus making it important to evaluate whether oral stimulation can benefit this group.

The results of the current study show that sensory-motor-oral stimulation associated with non-nutritive sucking can improve the oral feeding performance of preterm newborns and lead to decreased length of stay. In our study, preterm infants in the experimental group were ready to receive their oral diet earlier than the control group, independent of weight. They were similar when entering the study in relation to the following variables: birthweight, gestational age, Apgar scores, lowest weight, days of life upon recovering birthweight, weight, days of life and gestational age upon reaching full diet, and duration of orotracheal intubation. Since the guidelines for administering oral feedings followed a double-blind design, the large difference observed in this measurement may be due to the greater organization of sucking patterns. The superior feeding performance in the study group allowed these newborns to receive their exclusively oral diet earlier and thus be discharged earlier than the control group.

This study was not addressed to compare if this intervention is of more benefit than non-nutritive sucking alone. Further studies are needed to verify this question. Another is that we verified only clinical outcomes but we were able to demonstrate a difference in these outcomes, especially length of stay.

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Results of study variables in the two groupsa</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Experimental, n=49</td>
</tr>
<tr>
<td>Weight at introduction to oral feeding (g)</td>
<td>1647±142</td>
</tr>
<tr>
<td>Weight at full oral feeding (g)</td>
<td>1819±216</td>
</tr>
<tr>
<td>Weight at discharge (g)</td>
<td>1901±237</td>
</tr>
<tr>
<td>Weight gain in 1st week of study (g/kg/day)</td>
<td>15.6±6.8</td>
</tr>
<tr>
<td>Weight gain in 2nd week of study (g/kg/day)</td>
<td>21.6±7.0</td>
</tr>
<tr>
<td>Days of life at introduction to oral feeding</td>
<td>32.3±15.4</td>
</tr>
<tr>
<td>Days of life at full oral feeding (independent oral diet)</td>
<td>38.5±16.4</td>
</tr>
<tr>
<td>Days of life at discharge</td>
<td>41.9±17.4</td>
</tr>
<tr>
<td>Gestational age at introduction to oral feeding (weeks)</td>
<td>35.2±1.7</td>
</tr>
<tr>
<td>Gestational age at full oral feeding (weeks)</td>
<td>36.0±1.6</td>
</tr>
<tr>
<td>Gestational age at discharge (weeks)</td>
<td>36.5±1.7</td>
</tr>
</tbody>
</table>

**ANOVA, ***Wilcoxon test.

a Plus-minus values are means ±S.D.
In relation to length of stay, our results are similar to those already published by Measel and Anderson [16], Sehgal et al. [17] and Field et al. [15], who observed a decrease in time of stay of 4, 4.5 and 8 days, respectively. However, we should highlight that these authors only used the non-nutritive sucking technique, namely offering sucking with a pacifier during enteral feeding.

Sensory-motor-oral stimulation associated with non-nutritive sucking may have helped increase the maturation of neural structures, improving the performance in the coordination of sucking–swallowing–breathing. Learned experiences can influence the maturation of these functions [18–20].

No differences were observed between the groups in relation to weekly weight gain. This result may have been influenced by other factors.

Sensory-motor-oral stimulation associated with non-nutritive sucking is a simple measure providing benefits for very low birthweight infants and should be implemented in neonatal care units.

4. Conclusion

Based on our study, sensory-motor-oral stimulation, together with early non-nutritive sucking (as soon as the newborn reaches full diet) in low birthweight infants as long as they are clinically stable, should be implemented to promote earlier initiation of oral feeding and earlier hospital discharge, but we cannot recommend this practice against non-nutritive sucking alone. Further studies are required to address this issue.

Acknowledgments

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References


