Stimulation of sucking and swallowing to promote oral feeding in premature infants

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Abstract
Aim: To study the effect of stimulation of sucking and swallowing on weaning from nasogastric (NG) feeding and length of hospital stay in premature infants.

Method: Randomized controlled trial with blinded evaluation. Premature infants on NG feeds and post-menstrual age (PMA) less than 36 weeks who had poor ability to suck were randomized to receive one daily session of stimulation according to Vojta or no intervention other than standard nursing care.

Results: Of 36 infants, 18 received stimulation and 18 were observed without intervention. Mean gestational age at birth was 32.2 weeks (SD 2.4) versus 31.4 (2.3) weeks, \( p = 0.27 \), and PMA at study entry 35.1 weeks (0.8) versus 34.4 (0.9) weeks, \( p = 0.01 \), respectively. NG feeding was discontinued at 36.8 weeks (0.9) versus 36.3 (0.9) weeks’ PMA, \( p = 0.25 \), and they were discharged at 37.8 weeks (0.9) versus 37.7 (1.3) weeks, \( p = 0.81 \).

Conclusion: The stimulation programme did not result in earlier weaning from NG feeding or earlier discharge. However, such studies may need to be large to limit the possibility of type II errors.

INTRODUCTION
For premature infants, an often limiting factor for early discharge is their inability to feed sufficiently to obtain consistent weight gain. Successful oral feeding depends on neurological maturity to coordinate sucking, swallowing and breathing, sufficient power of oral muscles and an adequate sucking technique. Preterm infants may be able to root and grasp the areola as early as 28 weeks’ post-menstrual age (PMA), and have some ability of nutritive sucking at 30–32 weeks (1). Between 32 and 36 weeks, however, the infants still display an immature sucking pattern which may make breast- or bottle-feeding difficult (Review 2,3–5).

Attitudes and knowledge of the nursery staff and subsequent education and encouragement of mothers may improve oral feeding, and particularly breastfeeding (1,6). In addition, methods for stimulating the infant have been suggested in order to improve early oral feeding. In a monograph Morales describes orofacial regulation therapy (6) which is partly based on ideas from Vojta’s work (8). The concept is that the stimulation of specific areas of the body will elicit predictable activity of striate and smooth muscles through reflex pathways (8). Their techniques are, however, basically aimed at individuals with neuromuscular disorders, and to our knowledge they have not been evaluated scientifically. A meta-analysis of studies aimed at promoting oral feeding in preterm infants by specifically stimulating sucking and swallowing disclosed a lack of appropriate studies, and no definite recommendations could be made (9). Later, Fucile et al. have found that oral stimulation may result in earlier oral feeding, but not earlier discharge (10).

The present study was designed to investigate if daily stimulation of sucking and swallowing in premature infants with poor sucking ability would lead to earlier ability to feed orally and earlier discharge from the hospital.

PATIENTS AND METHODS
Preterm infants who were in the early stage of breast- or bottle-feeding and were judged to have poorer ability to suck than expected by the attending neonatologist and nurse, were successively referred to the study at a secondary neonatal intensive care unit. It was required that they were less than 36 weeks’ PMA and not on assisted ventilation, and that they had no somatic disease or neurological complications such as large subependymal bleeds or periventricular leucomalacia at the time of inclusion. The patient characteristics are described in Table 1. The study was approved by The Regional Committee on Medical Research Ethics, and written informed consent was obtained from at least one of the parents.

The infants were randomized using sealed opaque envelopes to oral stimulation (stimulation group) or no specific intervention (control group) in addition to the unit’s ordinary routine of weaning from intermittent nasogastric (NG) feeding. According to the nursing policy of the unit, all infants were regularly taken out of the incubator when they were sufficiently stable off ventilation, but not necessarily off nasal continuous positive airway pressure. Kangaroo care, sucking on the mother’s breast and subsequent breastfeeding were encouraged. Feeding by NG tube was performed approximately every 3 h. The NG tube was changed every third day. Enteral feeds with breastmilk were gradually increased to 20% of body weight per 24 h. When the weight increase was satisfactory on full NG feeds and the infant was taking at least 15 mL orally from breast or bottle,
supplementary NG feeding was initially provided to every other feed, but only to the total volume planned for that particular feed. Subsequently, the numbers of supplementary NG feeds were gradually reduced, and the NG tube was discontinued when most feeds were taken orally. Between 31 and 34 weeks' PMA, the infants were usually offered the breast only at every other feed.

The method of sucking stimulation was based on Vojta’s technique of initiating reflex activity of striate and smooth muscle (8). The chest and underneath the jaw (submental area) were the points of stimulation in order to obtain stabilization of the chest and extension of the cervical spine which is meant to facilitate coordination and effective interaction between sucking, swallowing and breathing (11). Furthermore, stimulation under the jaw is supposed to activate the muscles of the tongue and promote stretching of the cervical spine, which again is meant to facilitate movements of the tongue. The anatomical and physiological basis for sucking and swallowing and the presumed effect of the intervention has been described (12). The stimulation is also expected to improve intercostal and diaphragmatic activity resulting in increased intrathoracic volume and more efficient ventilation. The abdominal muscles and hip flexors will also be activated, which is observed as flexion of the hips during stimulation (8).

The children of both groups were taken to a separate room for the same length of time. Thus, neither parents nor nursing staff had any knowledge as to who were treated. The intervention group was treated for approximately 15 min once daily while the control group was left alone. The NG tube was kept in place until full oral feeds were established.

Formal calculation of sample size was not performed since the unexpectedly large standard deviations, the statistical power for detecting a benefit of 4 days and 1 week from the stimulation programme were 0.45 and 0.85, respectively. The statistical package SPSS version 12 (SPSS Inc., Chicago, IL, USA) was used for analysis. For continuous variables, means and one standard deviation (SD) were calculated. The groups were compared using two-sided Mann–Whitney U and Fisher exact tests. Outcome measures were PMA when NG feedings were discontinued and PMA at discharge home. Linear regression analysis was used to examine if other factors than stimulation versus observation had effect on outcome.

RESULTS
Of the 40 recruited infants, four were excluded because their gestational ages were more than 35 weeks. The remaining 36 completed the study. Eighteen received stimulation and 18 were observed without intervention. On average, the mothers of the infants receiving stimulation were younger, but there were no differences regarding marital status, parity or earlier breastfeeding experience (Table 1). For the infants, there were no differences regarding gender, single versus multiple births or neonatal morbidity as judged from the need of previous assisted ventilation, but the group receiving stimulation tended to have a higher mean gestational age, birth weight and PMA at study entry (Table 1).

There were no group differences in PMA when NG feedings were discontinued or when discharged home (Table 1). Adjusting for gender, parity, breast- versus bottle-feeding and PMA at study entry in a linear regression analysis did not affect the results. Based on the estimated large standard deviations, the statistical power for detecting a benefit of 4 days and 1 week from the stimulation programme were 0.45 and 0.85, respectively.

DISCUSSION
We found no significant benefit from the present method of stimulation of sucking and swallowing on weaning from NG feeding or PMA at discharge.

The strengths of the study were the random design, blind assessment of effects and robust outcome measures. A major weakness was the small size which resulted in limited statistical power due to the unexpectedly large standard deviations.

Table 1 Characteristics of the groups receiving stimulation (Stimulation) or observation (Control) presented as means and one standard deviation or proportions

| Characteristic                                      | Stimulation (n = 18) | Control (n = 18) | p-value
<table>
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<tr>
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<tr>
<td>Maternal age (years)</td>
<td>28.3 (4.4)</td>
<td>32.6 (6.1)</td>
<td>0.05</td>
</tr>
<tr>
<td>Mother married or cohabiting/single†</td>
<td>12/1</td>
<td>10/3</td>
<td>0.59</td>
</tr>
<tr>
<td>First child/older siblings</td>
<td>14/4</td>
<td>12/3</td>
<td>1.00</td>
</tr>
<tr>
<td>Gestational age at birth (weeks)</td>
<td>32.2 (2.4)</td>
<td>31.4 (2.3)</td>
<td>0.27</td>
</tr>
<tr>
<td>Birth weight (g)</td>
<td>1722 (532)</td>
<td>1576 (457)</td>
<td>0.39</td>
</tr>
<tr>
<td>Twins and triplets/single</td>
<td>6/12</td>
<td>9/9</td>
<td>0.59</td>
</tr>
<tr>
<td>Boys/girls</td>
<td>9/9</td>
<td>4/14</td>
<td>0.16</td>
</tr>
<tr>
<td>Been on assisted ventilation/no assisted ventilation</td>
<td>14/4</td>
<td>10/8</td>
<td>0.29</td>
</tr>
<tr>
<td>Full breastfeeding/partial or no breastfeeding at discharge</td>
<td>8/10</td>
<td>4/14</td>
<td>0.29</td>
</tr>
<tr>
<td>PMA at study entry (weeks)</td>
<td>35.1 (0.8)</td>
<td>34.4 (0.9)</td>
<td>0.01</td>
</tr>
<tr>
<td>PMA at stop of NG feeding (weeks)</td>
<td>36.8 (0.9)</td>
<td>36.3 (0.9)</td>
<td>0.25</td>
</tr>
<tr>
<td>PMA at discharge home (weeks)</td>
<td>37.8 (0.9)</td>
<td>37.7 (1.3)</td>
<td>0.81</td>
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PMA = post-menstrual age; NG = nasogastric tube.

*Missing for three in each group, †missing for four in the stimulation and three in the control group and ‡Mann–Whitney U and Fisher exact tests.
deviations. The difference in mean PMA between the groups at study entry was fortuitous, and the analyses suggest that neither this nor other minor differences altered the interpretation of the results.

As there were no previous studies for comparison at the time when the study was initiated, and it is open to judgement what may be considered a clinically significant effect, the study was considered exploratory, and no formal calculation of sample size was performed before deciding on the number of participants. The study shows, however, that such randomized trials need to be large or be limited to more selected groups of infants and possibly be initiated at a much earlier PMA in order to give reliable results. Indeed, in order to assess a benefit of 4 days with a power of 0.90 a sample of 160 patients would have been required in a cohort similar to the present one. It may also be a weakness that the treatment was given only once daily, but this was the suggested method and the method which the unit had felt to be effective during many years of experience.

In a meta-analysis, several approaches to boost oral feeding have been evaluated (9). From that review, it was suggested that early enteral feeding, oral stimulation before feeding and oral support during feeding may be of value. Oral stimulation was described as a few minutes of perioral and intraoral stimulation (13), and oral support as a manual stabilization of the jaw and buccal areas during feeding (12,14). With these techniques the preterm infants increased short term intake during a meal, but the studies were not designed to examine if the methods could result in earlier unsupported feeding or earlier discharge (9) which are the clinically important measures of effect. In a small study, Fucile et al. found that the infants receiving oral stimulation accomplished oral feeding more rapidly, but not in earlier PMA for discontinuing NG feeds or discharge home (10). Their infants were born at a substantially lower gestational age, stimulation was started earlier, and the technique was somewhat different. It is therefore possible that oral stimulation may be of benefit in settings different from ours. However, the PMA when independent oral feeding was established was similar to that of the present study despite the fact that our study was limited to patients who were recruited on clinical grounds because of poor ability to suck.

Interventions in addition to standard nursing care may require significant resources. In the present clinical setting the infants needed approximately 2 weeks from showing interest in substantial independent feeding until NG was discontinued and 3 weeks until discharge. Four days, therefore, seems to be a minimum benefit in order to justify additional resources.

More than anything, the present study underscores the importance of strict scientific testing of therapeutic approaches which are claimed to be effective. It also shows that such studies may need to be large in order to detect possible significant effects of a few days with sufficient statistical power.

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References