Factors Associated With the Transition to Oral Feeding in Infants Fed by Nasogastric Tubes

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Key Words: developmental therapy • feeding behavior • infant, low birth weight • oral motor function

Following a review of 100 infants fed by nasogastric tubes, medical factors associated with the length of transition to complete oral feeding were identified through correlational and multiple regression analyses. Six of the 100 infants had an extremely lengthy transition or never progressed to oral feeding, the remaining 94 infants progressed to oral feeding within 2 to 58 days. The total number of medical complications correlated significantly and positively with the length of transition. Digestive, respiratory, and cardiac complications were all significant predictors of the length of transition to oral feeding. The results of this study may assist occupational therapists in earlier identification of and intervention for infants fed by nasogastric tubes who are at risk for later oral feeding problems and a longer transition from nasogastric tube to oral feeding.

Literature Review

An increasing number of critically ill and immature infants survive today due to recent advances in neonatology (Benda, 1979; Handen, Mandell, & Russo, 1986). These infants present a variety of clinical conditions such as significant prematurity, congenital heart disease, central nervous system dysfunction, and respiratory disorders. Many of these infants are initially unable to meet their nutritional needs by oral feeding and are subsequently fed by nasogastric tubes (Moore & Greene, 1985). Occupational therapists have been challenged to serve this expanding population of tube-fed infants in an effort to meet their oral motor and feeding needs.

Typically, when the tube-fed infant has stabilized medically, the physician recommends oral feedings so that the nonoral feeding regimen can be gradually removed. At this point, the infant is often referred to occupational therapy for oral motor and feeding intervention, with oral feeding as a goal. Some infants make the transition from nasogastric tube feeding to oral feeding within a few days or weeks (Bernbaum, Pereira, Watkins, & Peckham, 1983; Field et al., 1982; Measel & Anderson, 1979), but others have difficulty making this transition, taking several months or years to become oral feeders (Van Dyke, Mackay, & Zjaylek, 1982; Vogel, 1986). For some infants, the transition to oral feeding never occurs (Handen et al., 1986). Literature addressing the complex needs of infants who have difficulty in making the transition from tube to oral feeding is limited, especially research studies that would assist in earlier identification and intervention for this growing population. The characteristics of those infants who make an early transition to oral feeding and how they differ from those who do not remains unknown.

The purpose of the present study was to learn more about the factors that affect the transition from nasogastric tube feeding to oral feeding in a large sample of infants. The results may be used clinically to help occupational therapists predict which infants may have difficulty in progressing to oral feeding. For these at-risk infants, earlier intervention may be initiated before oral motor problems develop in an effort to prevent their occurrence. Oral motor intervention is often not initiated until an oral feeding problem is identified. Earlier intervention for these at-risk infants could also help prevent the development of secondary problems associated with the long-term use of tube feedings.

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Premature infants often require nasogastric tube feedings because of an immature suck-swallow pattern (Morris & Klein, 1981; Moore & Greene, 1985). Premature infants with medical complications whose spontaneous oral intake is inadequate may also require this kind of nutritional support. Although nasogastric tube feeding may be used for extended periods of time (i.e., for several months or years), it is usually recommended as a temporary solution to oral feeding difficulties and is sometimes replaced with a gastrostomy tube after 2 or more months if oral feeding has not been established (Dobie, 1978; Logemann, 1983; Moore & Greene, 1985).

Complications of Long-Term Nasogastric Tube Feeding

Although nasogastric tube feedings may be essential in the prevention of malnutrition, complications related to physical discomfort have been documented frequently, especially with long-term use (Cataldi-Betcher, Seltzer, Slocum, & Jones, 1983). Such complications include nasal and pharyngeal irritation (Dobie, 1978), esophageal reflux with subsequent esophagitis (Shellito & Malt, 1985), and altered breathing patterns from the obstruction of one nasal passage by the feeding catheter (Benda, 1979, Erenberg & Nowak, 1984). These complications explain why nasogastric tube feeding is recommended for short-term use only (Moore & Greene, 1985). Any physical discomfort would compete with efforts to facilitate oral feeding.

Griffin (1979) noted a possible disinclination toward swallowing in some patients who have had trauma to the mucosa of the mouth or pharynx. DiScipio, Kaslon, and Ruben (1978) studied the effect of early oral trauma on later swallowing and proposed that swallowing problems may be partly related to maladaptive learning, independent of physical causes; they called this conditioned dysphagia. They hypothesized that conditioned dysphagia is likely to appear when severe esophageal trauma or trauma to bordering areas occurs during the early phases of central nervous system maturation. Nasogastric tube feeding provides aversive stimulation to the nasal and pharyngeal region and may be considered traumatic, especially if complications such as esophagitis occur. This trauma, then, is the unconditioned aversive stimulus that, when paired with swallowing, results in conditioned avoidance to swallowing on subsequent, less stressful stimulation of the esophagus or mouth. Consequently, attempts at oral feeding may act as conditioned stimulus resulting in the suppression of swallowing. The introduction of food into the mouth may cause such avoidance behaviors as physically expelling the food, gagging, pushing the food away, or vomiting (DiScipio et al., 1978).

Significance of Early Pleasurable Oral Feeding Experiences in Later Development

Early pleasurable feeding experiences are important for the infant's later psychosocial development. Positive early feeding is an important aspect in the development of bonding between parent and infant (Stroh, Robinson, & Stroh, 1986). It helps the infant develop a sense of trust and anticipate that new situations are likely to be more positive than negative.

Iltingworth and Lister (1964) proposed that a critical, or sensitive, period in infancy exists wherein the failure to introduce liquid or solid foods by mouth may result in future feeding problems. Infants fed by artificial methods of nutrition within their first several months of life may miss their sensitive period for eating. Tube-fed infants are frequently deprived of the opportunities to taste and swallow liquids (Bayer, Buehrs, & Kapp, 1983). Furthermore, the early use of nonoral feeding methods may interfere with the association of eating as a pleasurable experience (Geertsma, Hyams, Pelletier, & Reiter, 1985; Handen et al., 1986). Nasogastric tube placement is often perceived as noxious and can result in an initial rejection of oral input and feeding (Geertsma et al., 1985). Forced feedings may follow this rejection to eat, which further contributes to an already unpleasant experience. Early feeding difficulties may lead to a sense of mistrust. If the infant views eating as a threatening experience, then a conflict arises between the basic need to eat and the intense fear of doing so (Stroh et al., 1986).

Aside from the psychosocial implications of nonoral feedings on later development, occupational role development may also be affected negatively. Time spent being hooked up to feeding apparatus can easily limit the infant's amount of time and energy for play and family interaction (Stroh et al., 1986). Parents experience difficulties with their role, as well, because they are often frustrated and discouraged over the inability to feed their infant, an activity that is viewed as central to their role as parents.

In considering the importance of early pleasurable oral feeding experiences on later infant development and infant-parent occupational role development, occupational therapists must study and generate knowledge regarding oral feeding in infants fed by nasogastric tubes. The present study is timely in its effort to learn more about this growing population of infants and their transition to oral feeding.

Transition from Nasogastric Tube to Oral Feeding

Rapid transition to oral feeding was documented in three studies (Bernbaum et al., 1983; Field et al., 1982; Measen & Anderson, 1979) of premature infants free from any medical complications and sucking
problems. These studies measured the effects of non-
nutritive sucking on the transition to oral feeding. Al-
though the infants who received treatment began oral
feeding an average of 3 to 6 days earlier than the
control infants, both groups made the transition from
nasogastric tube feeding to oral feeding in fewer than
30 days.

Greene et al. (1981) used nocturnal nasogastric
tube feeding in patients with chronic renal disease,
surgical short bowel syndrome, malignancy, inflam-
matory bowel disease, and congenital heart disease.
Except for the patients with short bowel syndrome, all
patients made the transition to oral feeding within 1 to
3 months.

A lengthy transition from nasogastric tube feed-
ing to oral feeding has been documented in several
case reviews of infants with various medical complica-
tions. In a case review of infants with fetal alcohol
syndrome, the length of transition from nasogastric
tube feeding to complete oral feeding ranged from 10
to 14 months (Van Dyke et al., 1982). The authors
suggested that irritation caused by the nasogastric
and lack of oral feeding stimulation during the
first several months of life could have hindered oral
feeding progress. Vogel (1986) described the transi-
tion from nasogastric tube feeding to oral feeding in
an infant with a congenital heart defect. Although the
infants received occupational therapy for oral motor
and feeding problems, he had difficulty progressing
to oral feedings and was eventually given a gastrost-
tomy tube. Poor oral feeding progress was thought to
be a result of complications associated with long-term
use of nasogastric tube feedings, such as conditioned
dysphagia, nasopharyngeal irritation, and esophageal
reflux.

Although it appears that the presence of medical
complications may be a critical factor in influencing
the length of transition to oral feeding, this observa-
tion is based on studies of relatively few subjects.
Thus, the factors associated with length of transition
to oral feeding must be substantiated in a large sam-
ple of infants fed by nasogastric tubes. In the present
study, an ex post facto research design was used to
retrospectively review infants with various medical
conditions who received nasogastric tube feeding
within the first 6 months of life. The transition time to
total oral feeding was determined for each subject,
and medical factors (predictors) associated with the
transition to oral feeding were identified through
correlational and multiple regression analyses.

The intent of this type of correlational research is
to explore the relationships between variables, al-
though no manipulations are performed (Oyster,
Hanten, & Llorens, 1987). It allows for a broader focus
on the phenomenon being studied than is possible
with true experimental designs. The results of ex post
fato research are often used as a basis for further
studies using more powerful true experimental or
quasi-experimental designs (Oyster et al., 1987).

Method

Patient charts were reviewed for the first 100 infants
under 1 year of age who were admitted to Rainbow
Babies and Children's Hospital in Cleveland, Ohio,
between 1986 and 1988, who met the following crite-
ria: (a) they had been fed by nasogastric tube within
the first 6 months of life, and (b) they had a physi-
cian's order for oral feeding within the first year of
life.

The chart review was completed by a trained re-
search assistant. Reliability of data gathering was veri-
died during a pilot study and through random rating by
a second rater. Chart information was used to docu-
ment the criterion and predictor variables. The cri-
terion variable was defined as the number of days taken
to make the transition to complete oral feeding in
infants fed by nasogastric tubes. Complete oral feed-
ing was defined as the successful ability of the infant
to maintain nutritional requirements solely by oral
feeding without the use of supplemental tube feed-
ing. The beginning of complete oral feeding was de-
finite as the first day of a consistent 30-day period in
which the infant ate all meals by mouth. The predic-
tor variables, which consisted of those medical complica-
tions thought to influence transition time and that
were available in the chart, were chosen based on
information from the literature (Greene et al., 1981;
Vogel, 1986) and my clinical experience. These vari-
ables consisted of (a) the total number of medical
complications, (b) the number of neurological con-
ditions (diagnosis of seizures; diagnosis of intraven-
tricular hemorrhage; number of other neurological
diagnoses, including cerebral palsy and hydrocepha-
lus), (c) the number of respiratory conditions (diag-
nosis of respiratory distress syndrome; diagnosis of
bronchopulmonary dysplasia; number of other respira-
tory diagnoses, including aspiration and pneumo-
ia), (d) the number of digestive conditions (diag-
nosis of necrotizing enterocolitis; number of other di-
gestive diagnoses, including gastrointestinal reflux),
(e) the number of congenital cardiac defects, and
(f) the number of diagnoses related to the oral
structure (cleft palate, tracheostomy tube).

Summary variables were established by totaling
the number of conditions in the neurological, respira-
tory, digestive, and cardiac systems. I established a
summary variable for conditions influencing oral
structure by totaling the number of diagnoses that
may influence oral feeding, such as cleft palate, dys-
phagia, and tracheostomy. Gestational age at birth,
prematurity, Apgar scores at 1 and 5 min, and sucking
ability at the initiation of oral feeding were exploratory variables included as possible indicators of the infant's medical status. Sucking was rated as good (3), fair (2), or poor (1) based on information from nursing notes. This rating, which primarily depicts non-nutritive sucking, was the most consistent documentation of oral motor ability available in the charts. Although information regarding the efficiency and coordination of sucking and swallowing would have been a better indicator of oral motor ability, this information was not consistently available.

Results

Six of the 100 infants had an extremely lengthy transition from nasogastric tube to oral feeding when compared with the remaining 94. Two of these 6 infants made the transition in 14 and 36 months, respectively, whereas the other 4 never moved to oral feeding and consequently remained on gastrostomy tube feedings. The remaining 94 infants made the transition within 2 to 58 days. Because the 6 infants who had the

<table>
<thead>
<tr>
<th>Table 1</th>
</tr>
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<tbody>
<tr>
<td>Means and Standard Deviations for the Criterion and Predictor Variables</td>
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</table>

<table>
<thead>
<tr>
<th>Variable</th>
<th>Good Feeders (n = 94)</th>
<th>Poor Feeders (n = 6)</th>
<th>Good Feeders (n = 94)</th>
<th>Poor Feeders (n = 6)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>COSTERVATION VARIABLES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length of transition (in days)</td>
<td>17.56 (±11.59)</td>
<td>754*</td>
<td>2-58</td>
<td>413-4ever</td>
</tr>
<tr>
<td><strong>PREDICTOR VARIABLES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical complications</td>
<td>4.18 (±0.13)</td>
<td>8.66</td>
<td>0-9</td>
<td>6-14</td>
</tr>
<tr>
<td>No. of neurological conditions</td>
<td>0.42 (±0.68)</td>
<td>2.00</td>
<td>0-3</td>
<td>1-3</td>
</tr>
<tr>
<td>No. of respiratory conditions</td>
<td>1.87 (±1.44)</td>
<td>2.83</td>
<td>0-4</td>
<td>1-5</td>
</tr>
<tr>
<td>No. of digestive conditions</td>
<td>0.29 (±0.63)</td>
<td>1.83</td>
<td>0-3</td>
<td>1-3</td>
</tr>
<tr>
<td>No. of cardiac conditions</td>
<td>0.51 (±0.81)</td>
<td>1.16</td>
<td>0-3</td>
<td>0-3</td>
</tr>
<tr>
<td>No. of oral conditions</td>
<td>0.02 (±0.14)</td>
<td>0.83</td>
<td>0-1</td>
<td>0-2</td>
</tr>
<tr>
<td><strong>Exploratory variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apgar score at 1 min</td>
<td>5.12 (±2.39)</td>
<td>6.16</td>
<td>1-9</td>
<td>0-9</td>
</tr>
<tr>
<td>Apgar score at 5 min</td>
<td>7.41 (±1.40)</td>
<td>6.16</td>
<td>3-10</td>
<td>0-9</td>
</tr>
<tr>
<td>Sucking</td>
<td>2.69 (±0.64)</td>
<td>1.00</td>
<td>1-3</td>
<td>1-1</td>
</tr>
<tr>
<td>Gestational age (in weeks)</td>
<td>30.82 (±2.62)</td>
<td>37.66</td>
<td>20-40</td>
<td>26-40</td>
</tr>
<tr>
<td>Prematurity</td>
<td>1.90 (±0.30)</td>
<td>1.36</td>
<td>1-2</td>
<td>1-2</td>
</tr>
</tbody>
</table>

*Mean for the two infants who made the transition to oral feeding.

Table 2

<table>
<thead>
<tr>
<th>Variable</th>
<th>Good Feeders (n = 94)</th>
<th>Poor Feeders (n = 6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total no. of medical complications</td>
<td>+0.47*</td>
<td></td>
</tr>
<tr>
<td>No. of neurological conditions</td>
<td>+0.16</td>
<td></td>
</tr>
<tr>
<td>Seizures</td>
<td>+0.03</td>
<td></td>
</tr>
<tr>
<td>Intraventricular hemorrhage</td>
<td>+0.18*</td>
<td></td>
</tr>
<tr>
<td>Other neurological conditions</td>
<td>+0.08</td>
<td></td>
</tr>
<tr>
<td>No. of respiratory conditions</td>
<td>+0.33*</td>
<td></td>
</tr>
<tr>
<td>Respiratory distress syndrome</td>
<td>+0.20</td>
<td></td>
</tr>
<tr>
<td>Bronchopulmonary dysplasia</td>
<td>+0.18</td>
<td></td>
</tr>
<tr>
<td>Other respiratory conditions</td>
<td>+0.28</td>
<td></td>
</tr>
<tr>
<td>No. of digestive conditions</td>
<td>+0.35</td>
<td></td>
</tr>
<tr>
<td>Necrotizing enterocolitis</td>
<td>+0.30*</td>
<td></td>
</tr>
<tr>
<td>Other digestive conditions</td>
<td>+0.25</td>
<td></td>
</tr>
<tr>
<td>No. of congenital cardiac defects</td>
<td>+0.31*</td>
<td></td>
</tr>
<tr>
<td>No. of conditions related to oral structure</td>
<td>+0.07</td>
<td></td>
</tr>
<tr>
<td>Cleft palate</td>
<td>+0.07</td>
<td></td>
</tr>
<tr>
<td>Tracheostomy</td>
<td>-0.09</td>
<td></td>
</tr>
<tr>
<td>Exploratory variables</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apgar score at 1 min</td>
<td>-0.12</td>
<td></td>
</tr>
<tr>
<td>Apgar score at 5 min</td>
<td>-0.20*</td>
<td></td>
</tr>
<tr>
<td>Sucking status</td>
<td>+0.11</td>
<td></td>
</tr>
<tr>
<td>Gestational age (in weeks)</td>
<td>-0.29*</td>
<td></td>
</tr>
<tr>
<td>Prematurity</td>
<td>+0.06</td>
<td></td>
</tr>
</tbody>
</table>

Note: For one-tailed test, with alpha = .05, critical r = .17.

* p < .05

The primary hypothesis, that the number of medical complications correlates significantly and positively with the length of transition time to complete oral feeding, was tested through an evaluation of the Pearson product-moment correlation between the transition time and the total number of medical complications with the use of a one-tailed test. This correlation was significant at the .05 level (r = .47), thus indicating that the length of transition increases with an increasing number of medical complications (see Table 2).

For the second hypothesis, that certain medical complications are more closely associated with and better predict the length of transition from nasogastric tube to oral feeding, correlational and multiple regression analyses were used. All medical complications correlated significantly at the .05 significance level except seizures (r = .03), other neurological conditions (r = .08), cleft palate (r = .07), and tracheostomy (r = .09) (see Table 2). These correlational analyses indicate that the length of transition increased with the presence of those medical complications that were significant. In addition, Apgar scores at 5 min correlated significantly with the criterion variable (r = - .20), thus indicating a longer transition to oral feeding in infants with lower scores.
Table 3
Multiple Regression of Length of Transition With Summary Predictor Variables for the Good Feeders (n = 94)

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE B</th>
<th>β</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>8.65</td>
<td>2.08</td>
<td>-</td>
<td>4.17</td>
</tr>
<tr>
<td>No. of neurological conditions</td>
<td>2.18</td>
<td>1.58</td>
<td>.12</td>
<td>1.38</td>
</tr>
<tr>
<td>No. of respiratory conditions</td>
<td>2.32</td>
<td>0.97</td>
<td>.22</td>
<td>2.38*</td>
</tr>
<tr>
<td>No. of digestive conditions</td>
<td>6.51</td>
<td>1.65</td>
<td>.35</td>
<td>3.94**</td>
</tr>
<tr>
<td>No. of cardiac conditions</td>
<td>3.35</td>
<td>1.35</td>
<td>.23</td>
<td>2.48*</td>
</tr>
</tbody>
</table>

Note: \( R^2 = .28. \)
\* \( p < .05. \)
\** \( p < .01. \)

Multiple regression analyses were used to identify which types of medical complications would best predict the length of transition to oral feeding. Because only a small number of infants had conditions related to oral structure, this summary variable was left out of the equation. When neurological, respiratory, digestive, and cardiac summary variables for the good feeders were entered into the equation, digestive complications were significant at the .01 level and respiratory and cardiac complications at the .05 level, thus indicating these to be the strongest predictors of a longer transition to oral feeding (see Table 3). Twenty-eight percent of the variance in length of transition can be explained by the predictor variables in the regression equation.

All but one of the 6 poor feeders were full term, whereas most of the good feeders (90%) were premature. Prematurity \( (r = .06) \) was not significantly associated with length of transition in the good feeders. Those infants with a lower gestational age at birth, however, had a longer transition to oral feeding \( (r = - .29). \)

Table 4
Medical Complications of the Poor Feeders (n = 6)

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Transition to Oral Feeding (Days)</th>
<th>No. of Days on NG Tube, Before G Tube</th>
<th>GA at Birth</th>
<th>Neurological Condition</th>
<th>Respiratory Condition</th>
<th>Digestive Condition</th>
<th>Cardiac Condition</th>
<th>Oral Motor Condition</th>
<th>Total No. of Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>413</td>
<td>24</td>
<td>40</td>
<td>Brain stem dysfunction</td>
<td>RDS, Aspiration pneumonia</td>
<td>GE reflux</td>
<td>—</td>
<td>Dysphagia</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>1,095</td>
<td>30</td>
<td>40</td>
<td>Severe birth asphyxia, Severe cerebral palsy</td>
<td>Collapsed lung, Recurrent aspiration pneumonia</td>
<td>GE reflux, Esophagitis</td>
<td>—</td>
<td>—</td>
<td>7</td>
</tr>
<tr>
<td>3</td>
<td>Never</td>
<td>122</td>
<td>40</td>
<td>Cerebral atrophy, Seizures</td>
<td>Recurrent aspiration pneumonia</td>
<td>GE reflux, Esophagitis</td>
<td>—</td>
<td>Dysphagia</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>Never</td>
<td>65</td>
<td>40</td>
<td>Brain damage</td>
<td>RDS, Pneumothorax, Bilateral choanal atresia,</td>
<td>Chronic diarrhea, Tetralogy of Fallot, CHF</td>
<td>—</td>
<td>—</td>
<td>7</td>
</tr>
<tr>
<td>5</td>
<td>Never</td>
<td>131</td>
<td>26</td>
<td>IVH, Cerebral atrophy, Seizures</td>
<td>RDS, BPD, Severe pulmonary hypertension</td>
<td>NEC, Necrotizing enterocolitis, GI hemorrhage</td>
<td>CHF, Congestive Heart Failure</td>
<td>Tracheostomy</td>
<td>12</td>
</tr>
<tr>
<td>6</td>
<td>Never</td>
<td>204</td>
<td>40</td>
<td>Cerebral atrophy, absent corpus callosum</td>
<td>RSD, BPD, Respiratory acidosis, Hypoplastic lung, Bilateral pneumothorax</td>
<td>GE reflux, Esophagitis</td>
<td>CHF, Peripheral pulmonary stenosis, Cor pulmonale</td>
<td>—</td>
<td>14</td>
</tr>
</tbody>
</table>

Note: \( \text{NG} = \text{nasogastric}; \ G = \text{gastrostomy}; \ GA = \text{gestational age}; \ RDS = \text{respiratory distress syndrome}; \ GE = \text{gastroesophageal}; \ CHF = \text{congestive heart failure}; \ IVH = \text{intraventricular hemorrhage}; \ BPD = \text{bronchopulmonary dysplasia}; \ NEC = \text{necrotizing enterocolitis}; \ GI = \text{gastrointestinal}. \)
the transition to oral feeding first received temporary gastrostomy tube feedings. They were fed by nasogastric tube for approximately 1 month before receiving the gastrostomy tube. The remaining 4 infants, who did not progress to complete oral feeding, were fed by nasogastric tube for approximately 2 to 7 months before receiving gastrostomy tube feedings. The average total number of diagnoses was much higher for the 4 infants who never progressed to total oral feeding (9.7), compared with the average total number of diagnoses (6.5) for the 2 infants who eventually did (see Table 4). Because the size of this group was so small \(n = 6\), no statistical comparison to the good feeders \(n = 94\) was undertaken.

None of the infants in this study received occupational therapy for oral motor intervention at the onset of nasogastric tube feeding. For the poor feeders, intervention did not begin until approximately 1 to 2 months after onset of nasogastric tube feeding.

Discussion

The results support the first hypothesis that, in infants fed by nasogastric tubes, the number of medical complications will correlate significantly and positively with the length of transition time to oral feeding. The total number of medical complications was significantly correlated with transition time. Thus, even in the group of good feeders, an increased number of medical complications was associated with a longer transition time. A comparison of the mean total number of medical complications shows that the poor feeders were more critically involved than the good feeders (8.66 versus 4.18, respectively). These findings are further supported in the informal analysis of the 6 poor feeders (see Table 4). Of these 6 infants, the 4 who never progressed to oral feeding had a higher average number of medical complications \(m = 9.7\) than did the 2 poor feeders who eventually made the transition \(m = 6.5\). Thus, a higher number of medical complications may be used to predict infants at risk for a longer transition to oral feeding.

Although medical complications were seen in both groups, those of the poor feeders were much more severe. Transition time thus becomes a reflection of the severity of an infant’s problems. Clinically, these are the infants who should be treated earlier, and programs should be evaluated to determine whether early oral motor treatment will facilitate feeding progress.

The results also indicate that certain medical complications correlate significantly and positively with the length of transition to oral feeding in infants fed by nasogastric tubes. Diagnoses related to respiratory, digestive, neurological, and cardiac status were significantly associated with length of transition.

The only significant variable within the category of neurological conditions was intraventricular hemorrhage. All 6 of the poor feeders had one or more neurological conditions, most of which were severe (see Table 4). Neurological conditions were less common in the 94 good feeders. Seven of the good feeders had seizures, and 7 had other neurological conditions that were less severe (e.g., cerebral irritability) than those of the poor feeders (e.g., severe cerebral palsy). This might explain why the summary variable, neurological conditions, did not correlate significantly with length of transition in the good feeders. Minimal neurological damage may not be as detrimental to oral feeding as the effects of more severe problems.

Conditions related to oral structure were not significantly correlated with transition time in the good feeders. Of the entire sample, only 3 infants had a cleft palate and 3 had a tracheostomy. Two infants, 1 with a cleft palate and a tracheostomy and 1 with a tracheostomy, had difficulty with oral feeding (see Table 4). Both infants had more than 11 medical complications. In contrast, the other 2 infants with cleft palates and 1 with a tracheostomy in the group of good feeders had a lesser number, 3 or 4, of medical complications and moved to oral feedings within 2 months. This suggests that cleft palate and tracheostomy, by themselves, may not be indicative of severe oral feeding problems but may put the child at risk for such problems when associated with multiple complications. The only 2 infants in this study with a diagnosis of dysphagia were both poor feeders, thus suggesting dysphagia to be a strong indicator of oral feeding problems.

Although premature infants are at risk for oral feeding difficulties due to neurological immaturity, abnormal muscle tone, depressed oral reflexes, and an overall weak and irritable state (Morris & Klein, 1987), prematurity alone was not significantly and positively associated with the length of transition to oral feeding in the present study. This is not a surprising finding when one considers previous studies of premature infants without medical complications who progressed to oral feedings within 1 month (Bernbaum et al., 1983; Field et al., 1982; Measel & Anderson, 1979). Gestational age at birth, however, was significantly and negatively associated with length of transition, thus suggesting that the more premature the infant, the longer the transition to oral feeding. This is reasonable to expect because nutritive sucking, that is, the ability to coordinate sucking, swallowing, and breathing, is generally not well developed until 34 weeks gestation (Braun & Palmer, 1985). Many infants born under 34 weeks gestation would need to mature before becoming oral feeders and thus would have a longer transition period.

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Multiple regression analyses further support the second hypothesis that certain types of medical complications would predict the length of transition to oral feeding. The number of digestive as well as respiratory and cardiac conditions were significant predictors. These results may suggest that the digestive, neurological, and cardiopulmonary systems play an important role in the coordination and vigor of oral feeding. The literature regarding the negative effects of digestive, neurological, respiratory, and cardiac conditions on weight gain and oral feeding ability is supported in the results of the present study. If an infant has difficulty taking in an adequate amount of calories due to these problems, supplemental nasogastric tube feedings must continue.

Conditions related to digestive functioning were the most significant predictor of length of transition. Gastroesophageal reflux was the most common digestive complication noted in this sample. This condition, which causes constant irritation of the esophagus, may also cause esophagitis and reduce the infant’s desire to take food by mouth due to discomfort (Morris & Klein, 1987). Malnutrition is another complication of gastroesophageal reflux (Ferry, Selby, & Pietro, 1983). Ferry et al. (1983) studied the use of short-term nasogastric tube feeding in 12 infants with gastroesophageal reflux. A successful outcome of adequate weight gain and diminished vomiting occurred in all infants except those with other medical complications. These results suggest that the transition from nasogastric tube feeding to oral feeding may be slower in the presence of a combination of gastroesophageal reflux and other medical complications.

Neurological complications, including intraventricular hemorrhage and cerebral palsy, may negatively affect oral motor control, specifically the complex, coordinated act of sucking and swallowing, which is necessary for adequate food intake (Illingworth & Lister, 1964). Feeding problems have been noted in premature infants with severe intraventricular hemorrhage and central nervous system damage (Braun & Palmer, 1985; Harris, 1986). Swallowing problems may also be present with central nervous system damage and thus put the infant at risk for aspiration (Illingworth & Lister, 1964). Because a longer transition to oral feeding was associated with the presence of intraventricular hemorrhage in the good feeders, the results of the present study support previous studies.

Respiratory problems often alter breathing, which is critical to the success of sucking and swallowing. Poor feeding has been associated with bronchopulmonary dysplasia and other respiratory problems (Harris, 1986). With these problems, the suck-swallow pattern is poorly coordinated with breathing and may cause choking, coughing, or aspiration (Morris & Klein, 1987). This may lead to inadequate intake and the need for nasogastric tube feedings, which may further complicate matters by obstructing one naris, thus allowing only one naris for breathing while attempting to suck. This would further disorganize the suck-swallow pattern, causing even more difficulty in the progression to oral feeding (Benda, 1979).

Infants with cardiac defects have also been found to have oral feeding problems (D’Antonio, 1979; Posey, 1974). They tire easily and need to stop sucking frequently to catch their breath. In addition, sucking is often weak, with poor coordination of sucking and swallowing. This may explain why cardiac defects were found to be a significant predictor of a lengthy transition from nasogastric tube feeding to oral feeding in the present study.

Complications of Long-Term Nasogastric Tube Feeding

Four of the 6 poor feeders were fed with nasogastric tubes for 2 to 7 months before receiving gastrostomy tubes. Two of these infants subsequently developed gastroesophageal reflux and esophagitis, which may have been complications of long-term nasogastric tube feeding. One of these 2 infants also developed a behavioral aversion to oral feeding. She gagged and vomited upon food presentation. Although in the present study medical complications were associated with difficulty progressing to oral feeding, long-term use of nasogastric tube feeding may be an additional contributing factor. Gastrostomy tube placement may be beneficial in infants who are not likely to progress to oral feeding within 2 months. Nourishment provided through the gastrostomy tube allows the infant to engage in oral feeding activities without the aversive stimulus of the nasogastric tube. Additionally, the child may be better able to coordinate sucking and swallowing and to experience pleasure with oral feeding without the nasogastric tube (Morris & Klein, 1987).

Study Limitations

Several limitations of this study relate directly to the research design. First, although the results indicate relationships among variables, they do not necessarily infer causation. One must therefore take appropriate caution when interpreting the results. Second, the variables used in this study were limited to information that could be retrieved consistently from the
studied. For example, I could not consider the effect of the coordination of sucking and swallowing or sensorimotor processing on the transition to oral feeding because this information was not consistently available in the charts. These factors, among others, may account for the remainder of the variance, because only 28% of the variance could be explained by the predictor variables. A prospective study can now be initiated to study some of these factors.

Stronger predictive results would likely be obtained if a larger group of infants with a lengthy transition could be identified and compared with infants who make a rapid transition.

Conclusion

The results of this study suggest that infants with multiple medical complications who are fed by nasogastric tubes may be at risk for a lengthy transition to oral feeding, as are those infants with complications related to the digestive, cardiac, or respiratory systems. Certain neurological complications may also be associated with a difficult progression to oral feeding. Clinically, this information can be used by occupational therapists in an effort to prevent the development of both oral motor and feeding problems and secondary problems associated with the long-term use of nasogastric tube feeding in infants identified as at high risk for feeding problems.

Because referral for oral motor intervention usually does not occur until feeding problems are noted (Morris & Klein, 1987), the results of the present study may be used to predict which tube-fed infants are at risk for developing feeding problems so that intervention can begin earlier, before the problems develop. Because even the youngest premature infants will suck in some fashion, it seems reasonable to suggest that problems such as absence of the sucking reflex or aversion to oral stimulation can be prevented if anticipated (Harris, 1986). Early oral motor stimulation is recommended then, to maintain and further develop the sucking reflex with which the infant is born. Harris recommended that intervention programs for infants fed by nasogastric tubes consist of perinatal and intrarural touch-pressure and nipple- and finger-sucking experiences long before bottle feeding is recommended.

Although some infants fed by nasogastric tubes may be incorrectly predicted to be at high risk for developing oral feeding problems, early intervention for these infants may be justified. Several studies of premature infants without medical complications showed that frequent nonnutritive sucking experiences during nasogastric tube feeding can accelerate the transition from tube feeding to oral feeding and decrease length of hospital stay (Bernbaum et al., 1983; Field et al., 1982; Measel & Anderson, 1979).

Early oral motor intervention for infants fed by nasogastric tubes who are identified as at risk for a lengthy transition to oral feeding could also focus on the prevention of secondary problems associated with the long-term use of nasogastric tube feeding (Cataldi-Betcher et al., 1983; DiScipio et al., 1978). Occupational therapy could promote the use of pleasurable oral motor experiences to combat possible discomfort from the nasogastric tube and to develop a sense of trust. In addition, measures that would prevent the development of conditioned dysphagia should be taken. For example, if the infant has difficulty progressing to oral feeding within 2 to 3 months, a temporary gastrostomy tube may be recommended as a reasonable interim solution, because it is a less invasive method of nutritional support.

Previous studies have shown that early oral motor intervention decreases the length of transition from nasogastric tube feeding to oral feeding in premature infants without medical complications (Bernbaum et al., 1983; Field et al., 1982; Measel & Anderson, 1979). Future studies are needed to explore the effects of early treatment strategies in nasogastric tube-fed infants with medical complications who are at risk for oral feeding problems.

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