Clinical Tube Weaning Supported by Hunger Provocation in Fully-Tube-Fed Children

*Caroline M. Hartdorff, *C.M. Frank Kneepkens, †Anita M. Stok-Akerboom, ‡Elisabeth M. van Dijk-Lokkart, §Michelle A.H. Engels, and ||Angelika Kindermann

ABSTRACT

Background: Children with congenital malformations, mental retardation, and complex early medical history frequently have feeding problems. Although tube feeding is effective in providing the necessary energy and nutrients, it decreases the child's motivation to eat and may lead to oral aversion. In this study, we sought to confirm our previous results, showing that a multidisciplinary clinical hunger provocation program may lead to quick resumption of oral feeding.

Methods: In a crossover study, 22 children of 9 to 24 months of age who were fully dependent on tube feeding were randomly assigned to one of two groups: group A, intervention group (2-week multidisciplinary clinical hunger provocation program); and group B, control group (4-week outpatient treatment by the same multidisciplinary team). Patients failing one treatment were reassigned to the other treatment group. Primary outcome measures were at least 75% orally fed at the conclusion of the intervention and fully orally fed and gaining weight 6 months after the intervention.

Results: In group A, 9/11 patients were successfully weaned from tube feeding (2 failures: 1 developed ulcerative colitis, 1 drop-out). In group B, only 1 patient was weaned successfully; 10/11 were reassigned to the clinical hunger provocation program, all being weaned successfully. Six months after the intervention, 1 patient had to resume tube feeding. In total, in the control group, 1/11 (9%) was weaned successfully as compared with 18/21 (86%) in the hunger provocation group ($P < 0.001$).

Conclusions: Multidisciplinary clinical hunger provocation is an effective short-term intervention for weaning young children from tube feeding.

Key Words: behavioral intervention, behavior—eating, eating disorders, enteral feeding, hunger provocation

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What Is Known

- Feeding problems are common in children with mental retardation and complex medical history.
- Although tube feeding is effective in providing the necessary energy and nutrients, it decreases a child's motivation to eat and may lead to oral aversion.
- Studies aiming at weaning children off tube feeding are mostly based on behavioral approaches.

What Is New

- This multidisciplinary short program on clinical tube weaning supported by hunger provocation is an effective intervention for weaning young children from tube feeding with even long-lasting positiv results.

Feeding problems occur in 40% to 70% of children with congenital malformations, mental retardation, and complex early medical history (1,2), many of them being dependent on tube feeding. Although tube feeding is effective in providing the energy and nutrients needed for adequate growth and development, it decreases a child's motivation to eat, reduces positive oral stimulation, and results in a chronic noxious stimulus that may contribute to oral aversion (3,4).

A child not accepting oral feeding loses the ability to link eating to satisfying hunger. This interferes with the reintroduction of oral feeding and can result in behavioral problems and pathological food refusal (4,5). Managing these feeding problems and weaning the child off tube feeding are major challenges for both parents and health care workers. Studies aiming at weaning children off tube feeding are scarce; however, most are based on behavioral approaches and yield varying results (6).

In our pilot study (7), we evaluated intensive short-term, multidisciplinary clinical hunger provocation for the resumption of fully oral feeding in young children exclusively tube fed. This uncontrolled study yielded an 80% success rate, suggesting that such a program was feasible and effective. We realized, however, that working with a multidisciplinary team well trained in supporting parents with tube-dependent children could cause bias. Since we published our pilot study, no randomized controlled studies have been performed regarding this subject, most studies focusing on behavioral approaches and including only small numbers of patients (8–10). One program describes an outpatient transition approach based on pain rehabilitation (8); another concerns a long-term technique mainly based on parental anxiety reduction (10). The

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From the *Department of Pediatrics, the †Department of Nutrition and Dietetics, Internal Medicine, the ‡Department of Medical Psychology, the §Department of Neurology, VU University Medical Center, and the ||Department of Pediatric Gastroenterology, Emma Children's Hospital, Academic Medical Center, Amsterdam, The Netherlands.

Address correspondence and reprint requests to Angelika Kindermann, MD, PhD, Department of Pediatrics, Academic Medical Center, H7-250, Meibergdreef 9, PO Box 22700, 1100 DE Amsterdam, The Netherlands (e-mail: a.kindermann@amc.uva.nl).

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short-term feeding rehabilitation program described by Dunitz-Scheer and coworkers (11–13) has many similarities to our program, but has never been subjected to a controlled study.

Based on the results of our pilot study, we designed a study comparing clinical tube weaning supported by hunger provocation with intensive outpatient treatment supported by the same multidisciplinary team. The study was performed in the pediatric department of the VU University Medical Center (VUmc), a tertiary care hospital in Amsterdam, the Netherlands. The protocol was approved by the VUmc ethics committee.

METHODS

The study was designed as a crossover study with an intervention group (clinical hunger provocation, group A) and a control group (outpatient program, group B). Children were eligible for inclusion when they were younger than 2 years (corrected for prematurity) and fully dependent on tube feeding for at least 3 months. Exclusion criteria were the presence of anatomical, neurological, and functional disorders that could account for the feeding difficulties; the presence of a medical indication for tube feeding; and lack of parental informed consent. Between January 2006 and July 2010, 24 children fulfilled the criteria and were included in the study. Two dropped out before they could start (Fig. 1); 1 patient, allocated to group A, gradually started eating before admission for clinical hunger provocation and did not fulfill the inclusion criteria anymore; the other patient, allocated to group B, was admitted to the intensive care for a life-threatening respiratory infection.

Preinclusion Evaluation

Before inclusion, all children were evaluated by the multidisciplinary feeding team, consisting of general pediatrician, pediatric gastroenterologist, dietitian, speech-language pathologist, and clinical psychologist. The medical history was reviewed and pediatric examination was performed. Weight and length were assessed with a length board and a digital scale and interpreted in the light of a child's medical history. If judged necessary, additional investigations were performed to exclude organic disease. The speech-language pathologist evaluated oral motor function and sensibility and feeding skills. With a video fluoroscopic swallow study, food aspiration and penetration were ruled out. Psychological evaluation was performed by means of history to assess parent–child interaction, child behavior, parental concerns, and their capacity to bear the burden of the intervention. The dietitian estimated and calculated the daily nutritional intake by tube and orally. When necessary, the amount of tube feeding was adapted to reach optimal growth before the treatment was started.

Methods

After exclusion of underlying pathology, eligible patients were included and blindly randomized by one of the authors (A.K.), who did not know the patients and did not take part in the multidisciplinary team; of every 2 successive patients, the first was randomized blindly into either the intervention group (group A) or the control group (group B); the second was automatically allocated to the other group. In both groups, the multidisciplinary feeding team was directly involved in all steps of the program. In particular, the dietitian estimated and calculated the nutritional intake by tube and orally before start, at day 7 of the treatment and 1, 3, and 6 months after the study. She recommended, in consultation with the parents, the type and consistency of the oral feeding, the number of meals per day, and the daily schedule. She supported the parents during the clinical, outpatient, and follow-up periods. If possible, the nutrition was extended with respect to different types of foods, different flavors, and textures. The intention was to achieve a normal diet for their age. The clinical psychologist took care of the psychological support and behavioral

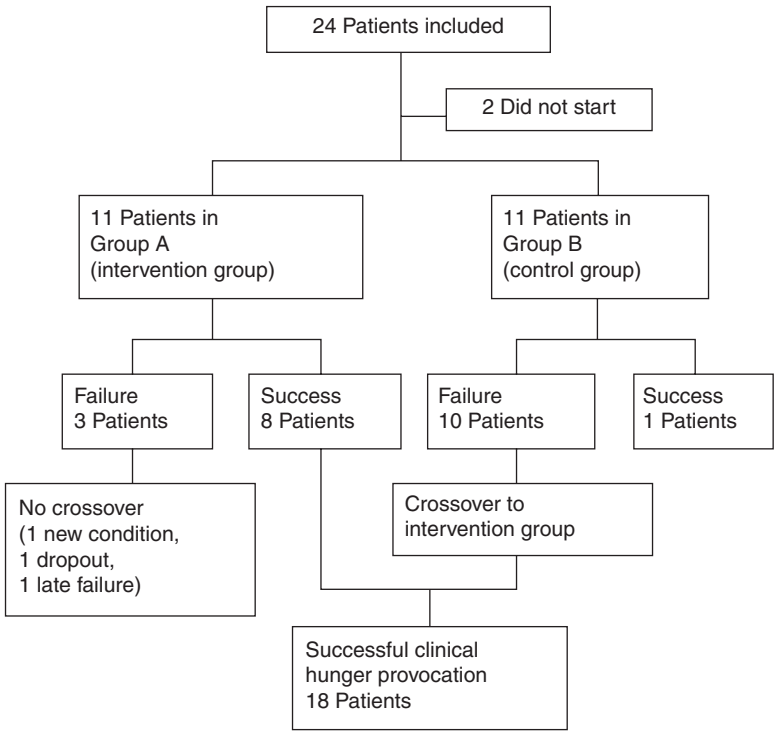

FIGURE 1. Flowchart of study groups and outcome.

counseling of parents and children by educating parents about feeding problems and behavioral aspects and explaining general and specific behavioral techniques. The speech-language pathologist gave advice about feeding techniques, seating posture, and types and textures of food to support oral feeding.

Group A (Intervention Group)

Children in group A were admitted for the hunger provocation program for a period of approximately 2 to 3 weeks (Table 1). The basic principle of the program is that withholding of adequate amounts of feeding provokes hunger, thereby stimulating the motivation to eat provided oral feeding is not forced. This is obtained by reducing the amount of feeding given by tube to 50% of the preadmission levels and decreasing it further to the mere substitution with water as insensible loss, estimated at 400 mL/m^2, after 6 days. Basically, every step in the program takes 2 days, but may be adapted to the individual progress of the patient. The children are monitored closely with physical examination once daily and weight assessment 3 times per week. In addition, vital signs, food and fluid intake, and urine and stool output are documented to monitor excessive weight loss and signs of dehydration, hypoglycemia, and constipation, as well as signs of infection. Weight loss up to 15% is accepted. To reduce negative stimuli as much as possible, only urinary ketone bodies are assessed, blood tests only being performed when deemed necessary.

Patients are granted feeding at fixed moments, 4 to 5 times per day depending on age. The feeding sessions are held in a quiet, distraction-free surrounding. Meal characteristics vary from patient to patient, adapted to individual preferences as much as possible. At first, a well-trained, experienced nurse feeds the patient in the absence of parents. The nurse is instructed to positively reinforce the child's behavior immediately after it accepts any amount of food. Negative reinforcement, such as physical pressure and forced feeding, is strictly avoided. The sessions are limited to 15 minutes unless the patient wants to continue eating, and end with an activity the child is known to enjoy. Only when the child is eating adequately, the parents take over (Table 1).

The multidisciplinary team convenes daily to discuss progress and decide on transition to the next treatment step. The clinical psychologist supports the parents and prepares them for the moment they take over feeding, for the test day at home and the final discharge.

Group B (Control Group)

Children in group B are seen in the outpatient clinic by the same interdisciplinary team once weekly for 4 weeks to provide optimal supportive care. The aim is to optimize the feeding offer and the acceptance of oral feeding. Parents are encouraged to feed their child while avoiding any pressure and to positively reinforce the child's behavior immediately after it accepts any amount of food, similar to group A. Weight is assessed weekly, whereas length is measured at the start and the end of the 4-week period. The speech-language pathologist evaluates the degree of acceptance of oral feedings and the possibility of increasing the feeding amounts. The dietitian followed the same protocol as in the intervention group. The only difference is that the reduction of the amount of feeding given by tube was 20% to 25% instead of 50% of the preadmission levels. The clinical psychologist supports the parents in minimizing stress related to the feeding difficulties and gives behavioral advice.

Follow-Up

After successful conclusion of the clinical or outpatient program, frequent contact between the parents and the multidisciplinary team is provided, according to the individual needs of the children and their parents. All of the patients are seen by the pediatric gastroenterologist after 1 to 2 weeks, 3 months, and 6 months. Food intake, nutritional changes, and eating behavior are documented and analyzed. The children are examined physically and weight and height are assessed and evaluated using appropriate growth charts (13).

Endpoints

Primary endpoints for both groups are accepting at least 75% of daily intake orally 4 weeks after starting treatment, and eating without tube feeding while gaining weight at 3 and 6 months after conclusion of the program. If after 4 weeks the treatment was considered unsuccessful (oral intake <75% of total intake), the patient was reallocated to the other protocol, which started as soon as possible and after a new informed consent of parents was given.

TABLE 1. Clinical hunger provocation procedure

Step	Duration, days	Intervention
1	2	Admission Tube feeding reduced to 50% of normal intake (preadmission level) No oral feeding; parents not present during (tube) feeding sessions
2	2	Start offering oral feeding by nurse Parents not present during feeding sessions Feedings directly afterward supplemented by tube up to 50%
3	2	Oral feeding by nurse; parents not present during feeding sessions Feeding supplemented to 50% during the night
4	2+*	All feeding provided orally, no supplemental tube feeding If needed, extra water by tube during the night to meet insensible loss
5	1–2	When oral intake exceeds insensible loss, removal of nasogastric tube Parents attend feeding session
6	1–2	Parents start feeding the child by themselves under the guidance of a nurse
7	—	Test day at home
8	—	Discharge

* May take several days, depending on progress. Procedure halted when weight loss reaches 15% of preadmission weight.

Statistical Analysis

SPSS version 21.0 (IBM SPSS Statistics, Armonk, NY) was used for all analyses. Descriptive analysis was performed to assess the (medical) characteristics of the sample and included means and standard deviations (SDs). Statistical analysis was performed using unpaired *t* tests for normally distributed continuous data and non-parametric tests for not normally distributed continuous data; and Fisher exact test or χ^2 test was used for comparing categorical data. Statistical significance was defined as $P < 0.05$. Correlations between variables were performed with Pearson correlation test for normal distributed data and Cramer V test for nominal data.

RESULTS

Patients

Twenty-two patients (11 boys) participated in the study, mean age 19.8 months (range 11–26 months), uncorrected for gestational age. All were dependent on tube feeding for at least 3 months (mean 16.3 months, range 4–26 months). They had withstood earlier interventions, including speech-language pathology, dietary changes, and behavioral treatment. All of the children but 1 had a complicated medical history (Table 2). Eleven patients started with the outpatient program and 11 with the clinical hunger provocation program. The groups were comparable regarding distribution of sex, age, length, weight-for-length SD, and age at start of tube feeding (Table 3). Six children in group A and 7 in group B had congenital malformations with or without chromosome defects; 2 children in group A and 2 in group B were born with gestational ages of younger than 28 weeks.

Intervention

In group A, clinical hunger provocation resulted in 9/11 patients (82%) successfully being weaned from tube feeding. Mean hospital stay duration was 14.4 (SD 3.0) days, mean weight loss 8.8% (SD 4.2%). At the time of admission, weights ranged between 6.3 and 14.1 (mean 10.5) kg; weight for length SD scores ranged between −2.39 and 1.44 (mean −0.48). Maximum weight loss ranged between 0 and 1600 (mean ± SD, 750 ± 500) g, which was between 0% and 15% (mean ± SD 7.4% ± 4.1%) of the weight at admission. Two patients failed the hunger provocation program. One child (no. 8) had 14% weight loss on day 12 with no signs of developing its own intake. Because of noncompliance of the parents, with the mother clinging onto her own ideas about feeding procedures, the program was stopped without crossover to the outpatient program, the patient being lost to follow-up. The other child (no. 5) developed fever and diarrhea during admission, necessitating interruption of the program. He was diagnosed with ulcerative colitis and could not be reallocated to the control group. Two children (nos. 15 and 16) developed viral infections not affecting the program. They were successfully weaned from tube feeding, and both were discharged after 17 days.

In group B, only 1 child (no. 1; weight at start 10.8 kg (−1.5 SD), weight loss 0%) was successfully weaned from tube feeding in the outpatient program. There was no significant weight change during the control intervention in any of the 11 patients. The 10 patients (91%) who remained dependent on tube feeding crossed over to the clinical hunger provocation program, resulting in successful weaning from tube feeding in all 10. Mean duration of admittance was 14.4 (SD 2.5) days, mean weight loss 5.9% (SD 3.5%). One child (patient 10) developed an upper respiratory tract infection not interfering with the program and was discharged after 14 days. In 1 child (no. 18), with 15% weight loss at hospital day 11, the procedure had to be interrupted and tube feeding resumed, but her interest in eating increased in the following days and she was discharged on day 20 with only 25% of her daily intake given by nasogastric tube.

TABLE 2. Clinical details of study group

Patient	Sex (tube feeding), mo	Age (at start of intervention), mo*	Age at start, mo	Preinclusion clinical diagnosis and risk factors
1	M	10	22	Hydrops fetalis, partial thoracic stomach with paraesophageal hernia
2	M	7	13	Cow's-milk allergy
3	F	2	11	Down syndrome, atrioventricular septal defect
4	F	8	25	Immature birth (25 wk), intraventricular hemorrhage, gastroesophageal reflux disease
5	M	0	25	Eventration of right and left diaphragm, pulmonary hypoplasia, recurrent severe infections
6	M	2	22	Maternal postnatal depression
7	M	0	24	Embryonic rhabdomyosarcoma in neck region, prolonged cytostatic treatment
8	M	0	19	Congenital diaphragmatic hernia, pulmonary hypoplasia, ECMO, hypoxic cerebral damage
9	F	11	16	Idiopathic progressive feeding problems from age 3 mo
10	F	0	13	Preterm birth (35 wk), complex cardiac anomaly, pulmonary hypertension
11	F	6	18	Immature birth (25 wk), tube feeding 0–3 mo
12	F	5	23	Psychomotor retardation, feeding problems from birth onward
13	F	7	11	22q11 deletion, hypogenesis of right lung complex, open heart surgery
14	F	0	24	Immature birth (25 wk)
15	M	0	17	Complex cardiac anomaly, chylothorax, ECMO, thrombosis of inferior vena cava
16	F	0	12	Preterm birth (36 wk), small-for-gestational age, frequent infections
17	M	0	23	Immature birth (27 wk)
18	F	0	21	Palatal cleft, gastroesophageal reflux disease, developmental delay, feeding problems from birth
19	M	0	26	Preterm birth (28 wk), facial cleft, bronchopulmonary dysplasia
20	M	3	24	Complex cardiac anomaly, gastroesophageal reflux disease
21	M	4	24	Prolonged postnatal hypotonia
22	F	11	22	Ring chromosome 18, mannose-binding lecithin deficiency, IgA deficiency

ECMO = extracorporeal membrane oxygenation; IgA = immunoglobulin A.
* With the exception of patient 1, the age refers to the age at which clinical hunger provocation was started.

TABLE 3. Comparison of study groups

	Group 1	Group 2	*P*
Sex (male:female)	5:6	6:5	0.67
Age at start of intervention, mo, mean ± SD	19.3 ± 5.0	20.3 ± 5.3	0.70
Duration of tube feeding, mo, mean ± SD	16.9 ± 7.6	17.4 ± 6.7	0.90
Length at start of intervention, SDS*; mean ± SD	−0.7 ± 1.4	−0.6 ± 0.8	0.90
Weight at start of intervention, SDS; mean ± SD	−0.5 ± 0.9	−0.2 ± 1.1	0.70

* SDS = standard deviation score.

Follow-Up

At follow-up after 4 weeks, 18/20 patients who had successful intervention (1 with outpatient treatment, 19 with clinical hunger provocation) were eating adequately and gaining weight (Table 4). One child (no. 21) experienced further weight loss in a period of frequent infections, but eventually resumed growth without further intervention. The second exception was the child discharged with 25% of daily intake given by tube (no. 18). She continued to lose weight and needed resumption of full tube feeding.

At follow-up after 3 and 6 months, all of the 18 children were eating adequately and gaining weight acceptably without tube feeding. One child (no. 2) even became obese with weights of 12.1 kg (1.5 SD) at discharge and 17.3 kg (4.0 SD) at 6 months, finally stabilizing at 3 SD.

In all, 3 patients could not be weaned from tube feeding. The child who developed ulcerative colitis (no. 5) was treated for this condition and, at age 9 years, still is partly dependent on tube feeding. The child who needed resumption of tube feeding (no. 18) accepted full oral feeding at age 3.5 years, after 1 year of behavioral therapy; at age 5 years, she is still growth retarded without an explaining diagnosis. The last information on the third child (no. 8) dates from 1 month after discharge, when he was still fully tube fed.

DISCUSSION

To our knowledge, this is the first prospective, randomized, controlled trial of a weaning program in exclusively tube-fed children. The results of this study confirm our preliminary report, showing the success of a short-term multidisciplinary in-patient program supported by hunger provocation in tube feeding–dependent children (7). All patients but one had complex medical histories contributing to the feeding problems; all were fully dependent on tube feeding, 10 of them from birth onward. Although only 1/11 patients was weaned from tube feeding with the outpatient program, all 10 failures were successfully weaned in the clinical hunger provocation program. Eventually, 21 patients were subjected to clinical hunger provocation, which was successful in 18 (86%).

One patient (no. 5) developed ulcerative colitis during admission. This condition, when recognized before inclusion into the study, would have been considered an exclusion criterion. A second child (no. 8) failed the program because of noncompliance of the parents. In retrospect, lack of parental motivation should have been an exclusion criterion. This underlines the importance of full cooperation of the parents in this setting. The third child (no. 18) had growth delay and massive regurgitation, which in itself does not seem to explain the failure.

The 18 children who were successfully weaned resumed eating at various paces, but within 1 week after starting clinical hunger provocation, and showed weight gain during the 6-month follow-up period. At the final follow-up visit, only 1 patient had not

TABLE 4. Details of progress during and after clinical hunger provocation (patients 2–22)

Patient no.	Started in group*	Weight at start, kg (W/L†)	Hospital stay, days	Weight at discharge, kg	Maximum weight loss, %	Oral intake after 4 wk, %	Weight after 3 mo, kg	Weight after 6 mo, kg (W/L)	Weaning successful
2	B	12.9 (1.44)	16	12.1	6	100	13.7	17.3 (3.31)	Yes
3	B	8.1 (−0.88)	12	7.7	5	100	8.0	8.3 (−3.10)	Yes
4	A	10.6 (−0.20)	12	9.9	6	100	9.7	10.5 (−1.10)	Yes
5	A	13,1 (0.30)	10	11.8	10	0	13.6	14.0 (−0.60)	No
6	B	12.5 (0.18)	12	11.7	6	100	12.6	12.6 (−0.17)	Yes
7	A	11.0 (−1.17)	15	9.8	11	100	10.9	10.9 (−1.53)	Yes
8	A	10.9 (0.22)	12	9.4	14	0	NA	NA	No
9	A	10.2 (−0.94)	12	9.8	4	100	9.9	11.2 (−1.31)	Yes
10	B	7.0 (−2.39)	14	6.7	4	100	6.4	7.3 (−3.26)	Yes
11	A	9.7 (−1.03)	13	8.7	10	100	9.0	10.0 (−1.46)	Yes
12	B	10.5 (−0.84)	15	10.5	0	100	10.6	10.7 (−1.92)	Yes
13	A	7.4 (−1.30)	13	7.3	1	100	7.9	7.9 (−1.53)	Yes
14	B	11.3 (0.30)	13	10.3	9	100	10.3	10.7 (−1.92)	Yes
15	A	9.5 (−0.91)	17	8.9	6	100	9.7	10.0 (−1.64)	Yes
16	A	6.3 (−1.68)	17	9.5	9	100	6.2	6.4 (−3.19)	Yes
17	B	11.4 (−0.48)	16	10.5	9	100	11.1	12.0 (−0.31)	Yes
18	A	9.2 (−1.14)	20	8.0	15	50	9.3	10.2 (−0.80)	No
19	B	11.3 (−1.54)	13	11.2	1	100	11.4	11.3 (−1.99)	Yes
20	B	13.2 (0.61)	20	11.7	11	100	11.3	12.3 (−1.13)	Yes
21	A	14.3 (0.89)	17	12.7	11	100	11.6	12.1 (−1.57)	Yes
22	B	9.3 (−1.00)	13	8.6	8	100	8.8	9.0 (−3.18)	Yes
Mean		10.5 (−0.48)	14.4	9.7	7.4 ± 4.1	—	10.1	10.8 (−1.35)	—

* Group A, intervention group (clinical hunger provocation); group B, control group (outpatient program).
† Weight for length (SD score).

regained his discharge weight, which was explained by multiple periods with infections, but he had started to grow and was thriving in every other way; therefore, we consider the intervention to be successful. Although mean weight for length for the whole group had dropped from −0.48 SD before to −1.35 SD 6 months after discharge, all of the 19 children showed a trend toward further recovery. From our pilot study, we have learned that after clinical hunger provocation, children eventually return to the preadmission growth parameters (7).

Given the fact that in young children tube feeding generally should be considered a temporary solution and resumption of oral feeding should have great priority, remarkably few studies provide practical solutions. In 2009, Davis et al (8) retrospectively evaluated a 14-week outpatient program for medically fragile toddlers, showing the combination of low-dose tricyclic antidepressant or gabapentin with megestrol as an appetite stimulant to be successful in weaning 8/9 patients from tube feeding. Harding et al (9) succeeded in reducing enteral feeding requirements in 2 toddlers with reflux disease and significant underlying conditions using an intensive 5-day group intervention program. The usual approach, however, is long-term ambulatory treatment, which in most children eventually will lead to weaning of tube feeding (10). In 2009, Dunitz-Scheer et al (11) presented the Graz Tube Weaning Program and their experience with 221 tube-dependent patients ages 4 months to 15 years, followed in 2011 by an overview of the results with a 3-week weaning program in 114 tube-dependent children with 80.7% success rate (12). Although never published in detail, this program seems to have much in common with ours. A recent study by the same group showed that using the same program, netcoaching is even effective compared with the intensive inpatient program (13).

Hunger results from the complex interaction of a variety of sensory input, limbic and cortical modulators, visceral feedback, and hormonal effects. The appetite control center resides in the hypothalamus. In a normal pediatric population, reduction of energy intake stimulates appetite and induces eating within a few hours (14). Rapid weaning promotes the experience of hunger, which is imperative to overcome oral feeding aversion. Creating and stimulating hunger is the drive to start eating. Although this is not different in tube-dependent children, the disturbed parent–child relationship with regard to eating may prohibit interrupting the vicious circle. Feeding children in the absence of their parents may provide the children with the opportunity to start with a clean slate. This intensive multidisciplinary program with significant energy restriction obviously necessitates careful monitoring of an experienced interdisciplinary team. In addition, the principle of hunger as motivation to eat, these children received more professional attention during their clinical stay compared with the control group. This may benefit the overall outcome and result in positive changes in parents' confidence, thought, and feeding performance, and a significant increase in a child's oral skills on the contrary. In this study, acceptable energy intake was achieved within a few weeks in children who may otherwise have been dependent on tube feeding for several years. Although we did not formally study quality of life in this group, we found that both parents and children gained from the program. It improved the children's wellbeing and the parent–child relationship and, in most cases, boosted the children's mental and motor development. We found that even the parents of the children who could not be weaned from tube feeding were glad they had the opportunity to make the effort. As far as cost is considered, clinical tube weaning supported by hunger provocation clearly is labor-intensive and costly but so is long-term tube feeding. Therefore, our program even may be cost-effective in the long run.

REFERENCES

1. Rudolph CD, Link DT. Feeding disorders in infants and children. *Pediatr Clin North Am* 2002;49:97–112vi.
2. Stevenson RD. Feeding and nutrition in children with developmental disabilities. *Pediatr Ann* 1995;24:255–60.
3. Byars KC, Burklow KA, Ferguson K, et al. A multicomponent behavioral program for oral aversion in children dependent on gastrostomy feedings. *J Pediatr Gastroenterol Nutr* 2003;37:473–80.
4. Mason SJ, Harris G, Blissett J. Tube feeding in infancy: implications for the development of normal eating and drinking skills. *Dysphagia* 2005;20:46–61.
5. Senez C, Guys JM, Mancini J, et al. Weaning children from tube to oral feeding. *Childs Nerv Syst* 1996;12:590–4.
6. Wilken M. The impact of child tube feeding on maternal emotional state and identity: a qualitative meta-analysis. *J Pediatr Nurs* 2012;27:248–55.
7. Kindermann A, Kneepkens CMF, Stok A, et al. Discontinuation of tube feeding in young children by hunger provocation. *J Pediatr Gastroenterol Nutr* 2008;47:87–91.
8. Davis AM, Bruce AS, Mangiaracina C, et al. Moving from tube to oral feeding in medically fragile nonverbal toddlers. *J Pediatr Gastroenterol Nutr* 2009;49:233–6.
9. Harding C, Faiman A, Wright J. Evaluation of an intensive desensitisation, oral tolerance therapy and hunger provocation program for children who have had prolonged periods of tube feeds. *Int J Evid Based Healthc* 2010;8:268–76.
10. Wright CM, Smith KH, Morrison J. Withdrawing feeds from children on long term enteral feeding: factors associated with success and failure. *Arch Dis Child* 2011;96:433–9.
11. Dunitz-Scheer M, Levine A, Roth Y, et al. Prevention and treatment of tube dependency in infancy and early childhood. *Infant Child Adolesc Nutr* 2009;1:73–82.
12. Dunitz-Scheer M, Marinschek S, Beckenbach H, et al. Tube-dependency: a reactive eating behavior disorder. *Infant Child Adolesc Nutr* 2011;3:209–15.
13. Marinschek S, Dunitz-Scheer M, Pahsini K, et al. Weaning children off enteral nutrition by netcoaching versus onsite treatment: a comparative study. *J Padediatr Child Health* 2014;1:1–6.
14. Shea S, Stein AD, Basch CE, et al. Variability and self-regulation of energy intake in young children in their everyday environment. *Pediatrics* 1992;90:542–6.