


# Outcomes of Blenderized Gastrostomy Feeding in Children at Rouen University Hospital

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**Purpose:** During the last few years, there has been an observed increase in the demand for blenderized tube feeding (BTF) in the outpatient setting among the caregivers of children suffering from chronic illnesses. This study aimed to assess the clinical and biochemical effect of BTF on children's general health and determine the psychosocial effect of this feeding type on their families.

**Patients and Methods:** This monocenter, retrospective study was conducted at the pediatric department of Rouen Hospital, France, and included ten children receiving a blended diet via enteral feeding tubes. Data were collected from the patients' profiles and by interviewing the caregivers to evaluate the clinical effects of BTF and its psychosocial effects on caregivers. Additionally, patients' medical records were reviewed for their nutritional status by assessing anthropometric measurements and biochemical markers recorded during follow-up visits.

**Results:** Ten patients were included (mean age, 6.2 years), and the mean BTF duration was 2.8 years. The patients were fed either homemade or commercial puree. Upper gastrointestinal symptoms such as vomiting improved rapidly after the introduction of blended food in six children (60%), where four experienced complete symptom regression and two showed marked improvement. Similarly, gagging and retching were alleviated in all cases. Diarrhea was alleviated in all cases, whereas constipation improved in three out of four patients. The families were satisfied with using natural BTF; however, caregivers cited the time taken to deliver blended food via syringe as a disadvantage.

**Conclusion:** We observed an improvement in gastrointestinal symptoms after the use of blended feeding by gastrostomy. Additionally, BTF had a positive psychological effect on caregivers.

**Keywords:** blenderized tube feeding, blended feeding, enteral feeding, gastrostomy

## Introduction

Enteral feeding via gastrostomy is a long-term nutritional support that is an essential part of the medical care of pediatric patients with feeding problems owing to swallowing difficulties. In most cases, these patients have a neurological impairment; therefore, it is necessary to provide them with essential nutrition requirements.<sup>1</sup>

Blenderized tube feeding (BTF) is the administration of blended food in the form of fine puree or liquid, which could be homemade or commercial (baby food products, including fruits, vegetables, dairy products, and meat).<sup>2</sup> This type of feeding is becoming popular in pediatric patients owing to their families' desire to introduce natural foods.<sup>3</sup>

Some studies have shown that the quality of life can be improved after switching from standard enteral formula to BTF for the children and their caregivers.<sup>4</sup> Blended diet feeding via gastrostomy can improve children's tolerance to enteral feeding and decrease gastrointestinal (GI) symptoms such as gagging, retching, and constipation.<sup>5</sup> Recently, some investigators reported presence of increased gut microbiota in children who received BTF.<sup>4</sup> In contrast, some health professionals consider BTF by gastrostomy unsafe because of the lack of solid evidence supporting its potential benefit, nutrient variability, risk of essential nutrient deficiency, and potential risk of foodborne illnesses.<sup>6</sup>

Studies on the clinical outcomes of BTF are still limited. Therefore, more research is needed to evaluate this feeding type.<sup>5,7</sup> Given the increasing number of patients in our center whose parents opted to use BTF through gastrostomy, this study aimed to

assess children's tolerance to this feeding type. Additionally, we investigated the clinical and biochemical outcomes in these patients and the psychosocial effects of BTF on caregivers.

## Materials and Methods

This retrospective, monocentric study was conducted by the pediatrics gastroenterology unit in Rouen university hospital. All included pediatric patients were followed up for 7 years (Jan 2015–2022) and used BTF through gastrostomy, either prescribed after the family demanded or owing to persistent GI symptoms resulting from complications of enteral nutrition. The study participants either had a neuromuscular disability or underwent surgery owing to congenital esophageal atresia.

Medical profiles were used to assess the clinical effect of BTF, including the information from the routine follow-up visits with the gastroenterologists and the dietitians at our center. Additionally, we completed our data by interviewing the caregivers, either over the phone or in person, during routine follow-up visits using a questionnaire prepared by the authors. The questionnaire covered the spectrum of digestive symptoms frequently observed in this population, including vomiting, retching, gagging, constipation, and diarrhea. Further, the evolution of symptoms and oral intake were assessed after initiating BTF.

The caregivers were then asked about other advantages and disadvantages of BTF using open-ended questions. They were explicitly asked if they faced tube blockage during the care of their children. Additionally, they were asked open-ended questions if they had psychosocial issues regarding their feelings about BTF use.

Anthropometric measurements were obtained from the patients' medical records, and blood investigations were conducted routinely during follow-up visits.

The children were closely monitored by dietitians. Our dietitians tailored the children's diet according to their requirements and family's food habits.

Statistical analysis was conducted using Microsoft Excel.

The study was approved by the ethics committee of Rouen University hospital (register number 785) and informed consent taken from the families to use the patient's data to conduct the study for the publication.

## Results

Ten patients were included in the study (Table 1). Of these, six were males, and the mean age was 6.2 years, with a mean duration of BTF by gastrostomy of 2.8 years. Three patients were on BTF for more than 2 years. Seven patients had

**Table 1** Characteristics of the Patients

Variables	Values
Age	
Range	1–12 years
Median	6.3 years
Mean	6.2 years
Gastrostomy duration	
Median	1.3 years
Mean	2.8 years
Pathology	
Esophageal atresia	n = 3 (30%)
Neurological disability	n = 7 (70%)
Fundoplication	n = 4 (40%)

**Table 2** Patients' Symptoms Before Blenderized Tube Feeding

Symptoms	Frequency(percent)
Vomiting	6 (60)
Gagging/retching	6 (60)
Constipation	4 (40)
Diarrhea	3 (30)

a neuromuscular disorder with chronic feeding difficulties, and three had esophageal atresia. Overall, four patients underwent Nissen fundoplication as a result of severe upper GI symptoms, and two were diagnosed with esophageal atresia.

All the children were switched to BTF at their families' request, either because they wanted to feed them natural food or because their child did not tolerate classic enteral feeding (Table 2). The number of meals administered by gastrostomy varied from one to four meals per day. Six children had more than three blended meals daily, and three patients had BTF exclusively.

Blended meals were delivered by boluses during the day or at night. The meals were prepared following the calorie and nutrient requirements recommended by pediatric dietitians in our hospital (Table 3). The bolus method was used after liquefaction of the blended food using water or milk. Usually, the bolus feeds were delivered over 10 to 20 minutes. Most caregivers gave either homemade or commercial blended diets, including vegetables, fruits, different meat types, and baby cereals mixed with milk. They also enriched the meals by adding foodstuffs such as oil and honey.

Caregivers' satisfaction levels, documented through interviews, were unanimous in our population. Caregivers were very happy to introduce real foods into their children's diet. The parents reported that their children were more comfortable with BTF. Three esophageal atresia cases showed improvement in oral intake.

In five cases, 44% of parents reported the time necessary to prepare the enteral food mixture and deliver it manually using a syringe (not a pump machine) as a disadvantage of BTF.

With a standard enteral diet, all patients had improved GI symptoms, including vomiting, gagging, retching, diarrhea, and constipation. Vomiting, especially after every feeding, was noticed in six patients. Gagging/retching was observed in a similar proportion of patients. Three out of four patients who underwent fundoplication experienced vomiting and gagging/retching with standard enteral feeding.

Additionally, all patients with esophageal atresia had severe upper GI symptoms. Four patients had constipation, and three had diarrhea with the standard enteral diet, among which two were diagnosed with esophageal atresia. Nine patients had symptom improvement after the introduction of blended feeding (Table 4). The caregivers noted rapid improvement in upper GI symptoms, notably vomiting, which improved in all patients ( $n = 6$ ). Furthermore, vomiting was completely resolved in four patients.

Gagging/retching improved in all patients having these symptoms (100%); therefore, the caregivers discontinued or reduced antacid administration. All patients with diarrhea ( $n = 3$ ) completely recovered after BTF, two of whom had a history of esophageal atresia, as did those with constipation except for one patient whose mother noticed no difference before and after BTF, considering that some parents still administered laxatives regularly but in lower doses.

Anthropometric measurements were collected from medical records. Body mass index (BMI) charts were unavailable for three patients owing to difficulties in measuring height in their clinical situation. For the five patients whose heights were available, none were underweight.

All the patients, except for one who we continued to follow-up in another hospital, had a routine blood test during their follow-up visit. These included complete blood count, urea and electrolytes, calcium, phosphorus, iron, ferritin, and liver function test; the results of the investigations were normal.

**Table 3** Duration, Number, and Characteristics of Blended Feeding and Associated Body Mass Index Percentile

Age	Duration of Blended Feeding	Number and Characteristics of Blended Feeding	Mixed Meal	Number of Enteral Classic Feeding Bolus	Body Mass Index Percentile
7 years	5.5 years	4 meals - 2 meals of whole-milk protein with cereals and 1 teaspoon of oil food - fruit juice 100 mL - 200 g baby commercial vegetable puree and meat with 1 teaspoon of oil food	0	0	75th
1.7 years	7 months	1 meal - commercial vegetable puree and meat 130g ± yogurt - baby cereal mixed with classic milk formula in 2 meals	2	2	10th
7 years	12 months	2 meals; homemade or commercial fruit puree or vegetable and meat	0	4	No height available weight in 50th
3.8 years	9 months	2 meals; commercial vegetable puree mixed with classic enteral formula	2	1 night	25th
12 years	9 years	4 meals; commercial vegetable puree with cereals		1 night	50th
9.5 years	8 years	4 homemade and commercial puree, including meats, vegetables, fruits, and cereals with honey added to 1 meal	0	0	No height available weight in 75th
2.9 years	1 year	4 homemade meals and commercial puree including meats and vegetables, fruits 1 meal with baby milk formula	0	0	50th
5, 6 years	1 year	3 commercial puree including meats, vegetables, and yogurt	0	2	85th
3 years	1.6 months	4 meals commercial puree including meats, vegetables, and fruits		1	25th
9.7 years	1.6 year	1 commercial fruit puree		2	No height available

**Table 4** Symptom Improvement After Blenderized Tube Feeding in the Study Participants\*

Variables	Improved	Disappeared	Unchanged
Symptomatic patients	9	0	1
Patients with vomiting	2	4	0
Patients with gagging/retching	5	1	0
Patients with constipation	2	1	1
Patients with diarrhea	0	3	0
Patients with oral intake	3	0	7

**Note:** \*Data are presented as frequency (percent).

Five patients had their vitamin A, D, E, and C levels measured routinely every 6 or 12 months. Mild vitamin A deficiency was noted in only two of five children with neuromuscular diseases.

Oral feeding improved in three patients after the introduction of BTF. Gastrostomy tube occlusion was not uncommon and occurred in two patients. In one case, tube occlusion occurred during the delivery of medications, and the other occurred only once during a seven-year period and was flushed easily with Coca-Cola and water. Six patients had gastrostomy tube size 12 FR, and the rest had size 14 FR.

## Discussion

Upper GI symptoms like retching, gagging, and emesis are most likely caused by gastroesophageal reflux and motility dysfunction, causing stasis in the esophagus of patients with chronic neurologic disability,<sup>8–10</sup> who represented 66.6% of our study population. Additionally, it is known that complications are associated with fundoplication, including worsening of feeding disorder and dumping syndrome, which present as retching, gagging, emesis, and diarrhea.<sup>11,12</sup> Four patients in this study had fundoplication, among which three had a history of esophageal atresia.

The improvement of upper GI symptoms in this study is similar to those reported in a retrospective monocentric study including 23 patients. Batsis et al<sup>10</sup> reported an improvement of upper GI symptoms in 95% of their patients. Additionally, they observed that oral intake was improved in 53% of the cases, with 9% of the patients transitioning to exclusively oral feeds. However, new-onset constipation was observed in 21% of the cases.<sup>10</sup> Conversely, in our study, all the children with constipation improved and required smaller stool softener doses.

In another study including 33 children with feeding disorders after fundoplication surgery, Pentuik et al<sup>11</sup> observed that gagging and retching improved in 76–100% of the patients. Additionally, they observed an increase in oral intake in 57% of children with feeding disorders after fundoplication surgery.<sup>11</sup> The improvement in gastroesophageal reflux could be owing to the increased viscosity of the blended meal. Dumping syndrome may have improved owing to decreased gastric emptying resulting from the use of a blended diet, which had a higher viscosity than the standard formula.<sup>11</sup> Another theory suggests that with BTF, digested chyme may reach the small intestine at a pace that stimulates a more regular hormonal response of neurohormones, such as bradykinin, cholecystokinin, and vasoactive intestinal polypeptide, thus, promoting more physiologic motility and reducing symptoms.<sup>5,10</sup>

Microbiota changes with BTF, a process which has been described by Gallagher et al<sup>4</sup> might explain the improvement of lower digestive tract symptoms (constipation and diarrhea).

One of the main concerns with a blenderized diet is that the food and nutrient contents might be inadequate and affect a child's growth. In our study, nutritional statuses were appropriate. Patients who received BTF had regular growth curves. BTF did not result in a negative effect on growth, which is in line with the results from other studies.<sup>10,11</sup> Two of our patients had a mild deficiency in vitamin A probably because of a deficiency in supply; however, vitamin A levels were not measured before BTF. No other deficiency in macronutrients or micronutrients was observed in our study population.

The children were closely monitored by dietitians. Our dietitians tailored the children's diets according to their requirements and family's food habits, which was more time-consuming than prescribing industrial products. The use of a blenderized diet for children fed via a gastrostomy is a contentious issue for clinicians owing to the lack of evidence demonstrating its benefits.<sup>5–7</sup> Consequently, health professionals usually strongly advise using industrial products in gastrostomy-fed children.<sup>13</sup> Also, we believe that some families are not encouraged to express their desire to give blended food to their children. Furthermore, in families who initiate a blended diet, nutritional intakes are not usually monitored. Another concern is the occurrence of foodborne illnesses,<sup>6,14</sup> which was not observed in our patients possibly because the food was given rapidly by boluses without allowing time for microbial pullulation at room temperature.

BTF is cheaper than the standard enteral formula.<sup>11</sup> Standard enteral formula costs on average four to six euros per meal, while blended feeds cost one to three euros per meal and are not covered by insurance companies. In France, most industrial products are reimbursed by social security. However, the theoretical disadvantage of paying for BTF was not an issue for the caregivers in our study and was on par with the satisfaction of giving natural food or family meals. The

lower cost of BTF might be an advantage in countries where the cost of industrial products is not covered, and it could help decrease health care costs.

Reportedly, there is an increased risk of feeding tubes becoming blocked by a blended diet, and gastrostomy tubes should not be less than 14 FR. However, one study reported that none of the five different handmade formulas tested in their study blocked 10 FR gastrostomy tubes.<sup>6,15</sup> In our study, tube blockage was reported only once with blended feeding, and it was flushed easily. Approximately 66.6% of the children in our study had size 12 FR gastrostomy tubes, while the other children had 14 FR. Hence, it appeared that the tube size was not an issue.

The caregivers in our study reported being psychologically satisfied with the administration of BTF. Parents were happy to give “real food” instead of industrial products. They expressed a sense of normalcy by buying regular baby food and preserving a nurturing link by cooking homemade meals.

Our study had some limitations. It is a retrospective study with a small number of patients. In some patients, anthropometric measurements such as height were lacking. However, our results are relevant and warrant consideration. For example, some parents reported improved GI symptoms after feeding their children with blended food via a gastrostomy tube. None of the caregivers complained of worsening symptoms since initiating BTF.

## Conclusion

Despite the small number of our sample, the administration of a blended diet through a gastrostomy tube could be considered beneficial in improving the quality of life of pediatric patients. GI symptoms improved in our patients, and their nutritional status was maintained. Additionally, we did not observe any negative outcomes associated with BTF, and their families expressed emotional satisfaction from feeding them through BTF. Therefore, BTF could be a useful tool to improve digestive symptoms in neurologically impaired children.

BTF is often requested by a caregiver, which can be granted provided the patient is followed up closely by a dietitian. Nevertheless, prospective multicenter studies are warranted to confirm improvements in morbidity and quality of life and establish guidelines that provide patients with adequate nutritional needs.

## Abbreviations

BTF, blenderized tube feeding; BMI, body mass index; GI, gastrointestinal.

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## Disclosure

The authors report no conflicts of interest in relation to this work.

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