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ORIGINAL CONTRIBUTIONS

Improvement in Food Intolerance Resulting from Roux-En-Y Gastric Bypass after Speech Therapy Intervention in Chewing

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Abstract

Introduction Food intolerance is expected during the postoperative period following gastric bypass and may be associated with inadequate chewing.

Objective To evaluate chewing before and after speech therapy intervention in subjects undergoing Roux-en-Y gastric bypass who present with food intolerance.

Materials and Methods This was a randomized controlled trial, approved by the Brazilian Ethics and Research Committee under n. 438,600. The study population was allocated into two groups: the study group (SG), who received speech therapy intervention, and the control group (CG), who did not receive any intervention, in six visits at 7, 15, 30, 60, and 90 days (v7, v15, v30, v60, and v90) after the initial visit (v0). During v0 and v90, a chewing evaluation was performed according to the MBGR protocol adapted. The significance level adopted was 5%.

Results A total of 30 females (88%) and 4 males (12%) were analyzed. The SG had 18 subjects, and the CG had 16, with mean ages of 50.17 ± 12.28 years and 45.69 ± 9.78 years, respectively. The postoperative time ranged from 4 to19 months. In the SG, a marked improvement in the number of episodes of food intolerance was observed ($p < 0.001$), an improvement in the intake of cereals and meats ($p = 0.004$ and $p < 0.001$, respectively), and an improvement in chewing capacity and swallowing ($p = 0.002$ and $p = 0.011$, respectively).

Conclusion Speech therapy intervention in chewing led to a marked improvement of food acceptance and food intolerance resulting from Roux-en-Y gastric bypass.

Keywords Bypass surgery · Food intolerance · Chewing

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Introduction

Among the bariatric surgeries performed worldwide, the most common are Roux-en-Y gastric bypass and vertical gastrectomy (sleeve) [1]. Both techniques restrict the gastric volume, which can lead to food intolerance of variable intensity during the early postoperative period due to the new anatomical and physiological conditions of the subject. However, if persistent, food intolerance can lead to food avoidance or improper eating behavior and may result in eating habits that affect the overall quality of the diet, increase the risk of nutritional deficiencies, and/or compromise weight loss. Studies performed with post-surgery subjects identified dietary and nutritional problems [2–4]. The most frequent complaints during the first weeks after surgery are nausea and vomiting, but vomiting improves in 75% of subjects after 1 and 6 months [5]. Such symptoms may be associated with poor diet adherence, volume intake greater than the new stomach capacity, and/or inadequate chewing [6].

Chewing involves structures and functions of the stomatognathic system that are evaluated and treated by specialized speech therapy professionals [7, 8].

Aim

To evaluate chewing before and after speech therapy intervention in subjects who underwent Roux-en-Y gastric bypass surgery and present with food intolerance and compare the results to determine symptom improvement.

Methods

This was a randomized controlled trial conducted at a single center and consisting of a study group (SG) and a control group (CG). The study was registered in the Brazil Platform (Plataforma Brasil) and approved by the Ethics and Research Committee under opinion n. 438,600. All participants signed an informed consent form prior to data collection.

Sample Selection

The study included 34 volunteers treated by the Brazilian Unified Health System. The volunteers were randomly allocated to the SG (speech therapy intervention) or CG (no intervention) using the website www.randomization.com. The inclusion criteria were as follows: presenting food intolerance symptoms persisting in the fourth month and at a maximum of 2 years after the surgical intervention, adequate diet intake according to the nutritionist's guidelines, and adherence to the post-surgery follow-up visit schedule. In all subjects, the mechanical or associated causes of food intolerance, such as cholelithiasis, gastric ulcer, and obstruction of the gastrointestinal tract, were removed by the clinical staff through examinations such as abdominal ultrasound, upper digestive endoscopy or esophagus, and stomach and duodenum contrast radiographic study. Regarding food intolerance, the symptom of malaise was defined as encompassing discomfort after food consumption, such as food sticking in the throat, choking, swallowing discomfort, abdominal pain, sensation of a heavy stomach, post-meal fullness, nausea, vomiting, dumping, and sweating. The symptom of vomiting was defined specifically as food expelled via the oral cavity, and malaise culminating in vomiting was defined as the discomfort experienced after food consumption followed by food expulsion [9, 10]. The distribution and characterization of the subjects are shown in Table 1.

Table 1 Sample characterization

Sample characterization	Study group								Control group							
	N	Mean	Median	Std. deviation	Minimum	Maximum	Percentiles		*N*	Mean	Median	Std. deviation	Minimum	Maximum	Percentiles	
							25	75							25	75
Age	18	50.17	54.00	12.28	25.00	67.00	39.00	60.00	16	45.69	45.50	9.78	25.00	63.00	38.75	50.50
Postoperative time (months)	18	7.94	5.50	4.49	4.00	18.00	5.00	10.50	16	6.81	5.00	4.34	4.00	19.00	4.00	8.00
Weight (kg)-V0	18	95.09	90.10	21.72	50.00	137.85	84.55	100.75	16	96.90	97.98	15.64	68.40	136.20	89.71	104.09
Height (meters)-V0	18	1.60	1.57	0.10	1.49	1.83	1.53	1.62	16	1.60	1.60	0.07	1.50	1.76	1.54	1.65
BMI-V0	18	37.46	36.83	8.39	20.55	58.13	33.87	40.76	16	38.01	38.11	5.99	25.12	48.84	34.09	42.22
Weight (kg)-V90	16	92.37	86.98	12.23	64.50	128.30	80.30	101.06	16	91.26	91.08	12.57	69.00	123.60	85.76	98.30
Height (meters)-V90	16	1.60	1.57	0.10	1.49	1.83	1.52	1.62	16	1.60	1.60	0.07	1.50	1.76	1.54	1.65
BMI-V90	16	36.40	35.54	7.03	25.51	54.10	32.14	40.35	16	35.75	35.64	4.45	26.34	44.32	33.08	38.36

Procedures

Six visits were conducted for subjects of both groups: the initial visit (v0) and another five visits after 7, 15, 30, 60, and 90 days (v7, v15, v30, v60, and v90, respectively). In visits v0 and v90—evaluation of stomatognathic system structures and functions—the subjects were evaluated regarding orofacial myofunctional aspects, chewing and swallowing of food with solid, thickened paste and liquid consistencies based on a speech therapy protocol [11, 12]. All subjects were asked to complete five follow-up forms on the number of episodes of food intolerance after food intake, pertaining to the 7 days of the week, including the following six daily meals: breakfast, morning snack, lunch, afternoon snack, dinner, and evening snack. The dates for completing the forms were previously established and preceded visits v7, v15, v30, v60, and v90. The SG subjects received speech therapy intervention during visits v7, v15, v30, and v60 Table 2. The intervention consisted of chewing and swallowing orientation and training using the same foods with solid, thickened paste and liquid consistencies from the speech therapy protocol [11]; filming of chewing for evaluation and analysis of behavioral change; and printed material orientation to facilitate the memorization and training of chewing and swallowing on a day-to-day basis.

Table 2 Speech therapy intervention by in-person orientation and training using foods with solid thickened paste and liquid consistencies. List of maneuvers in the SG

The individual therapy carried out in studied group through personal training acted corresponding the aspects listed below:

1. In the mechanical phases of chewing
   (a) Food incision—incisor teeth
   (b) Food crushing—pre-molar teeth
   (c) Food spraying—molar teeth
2. In masticatory act
   (d) Mouth-opening phase
   (e) Mouth closing
   (f) Occlusion or masticatory blow—isometric contraction
   (g) Mandible dislocation
   (h) Dental occlusion in chewing
   (i) Dental contact time
   (j) Head balance in chewing
3. In swallowing
   (k) Head balance in swallowing
   (l) Pressure gradient—tongue base, tongue action, pharynx wall, larynx
   (m) Aboral reflux prevention—previous mouth sealing
   (n) Airways protection—palate apposition against the pharynx wall, larynx lifting and traction
   (o) Vomiting inhibition—low-threshold receptor stimulation and the point of food entry acting

Statistical Analysis

The data were tested for normality using the Kolmogorov-Smirnov test. Continuous variables with normal distributions were compared by Student's *t* test, and variables with non-normal distribution were compared using the Mann-Whitney *U* test. Categorical variables were compared with the Chi-square test, and when necessary, Fisher's test was used. The level of significance was set at 5 %. The statistical program used was SPSS version 2.0.

Results

The SG group included 18 individuals, and the CG group included 16 individuals with mean ages of 50.17 ± 12.28 years and 45.69 ± 9.78 years, respectively. The postoperative time ranged from 4 to 19 months for the SG (7.94 ± 4.49 months) and CG (6.81 ± 4.34 months) Table 1.

Regarding the clinical symptoms after food intake at visit v0, in the SG, eight (44.4%) subjects reported experiencing episodes of malaise, and eight (44.4%) reported malaise culminating in vomiting. In the CG, five (31.3%) subjects reported experiencing episodes of malaise, and ten (62.5%) reported malaise culminating in vomiting. At visit v90, i.e., 90 days after v0, in the SG, 15 subjects (83.3%), and in CG, only two subjects (12.5%), were symptom-free after food intake ($p < 0.001$) Table 3.

The food intolerance symptoms were monitored by recording the number of episodes of malaise, vomiting, and malaise culminating in vomiting on five forms. There was an improvement in the number of episodes of food intolerance when the data from v0 and v90 were compared Figure 1.

Regarding the less tolerated foods, in v0, cereals and meats were reported by both groups. In v90, an improvement in eating was observed in the SG, including cereals and meat ($p = 0.004$ and $p < 0.001$, respectively) Table 4.

The predominant food consistency at v0 was thickened paste for nine (50.0%) subjects and solid for six (33.3%) in the SG and was thickened paste for seven subjects (43.8%)

Table 3 Clinical symptoms of food intolerance

Clinical symptoms of food intolerance (*n*, %)	V0			V90		
	Study group	Control group	*p*	Study group	Control group	*p*
No symptom	1 (5.6)	0 (0.0)	0.614	15 (83.3)	2 (12.5)	< 0.001
Malaise	8 (44.4)	5 (31.3)		2 (11.1)	4 (25.0)	
Vomiting	1 (5.6)	1 (6.3)		1 (5.5)	1 (6.3)	
Malaise and vomiting	8 (44.4)	10 (62.5)		0 (0.0)	9 (56.3)	

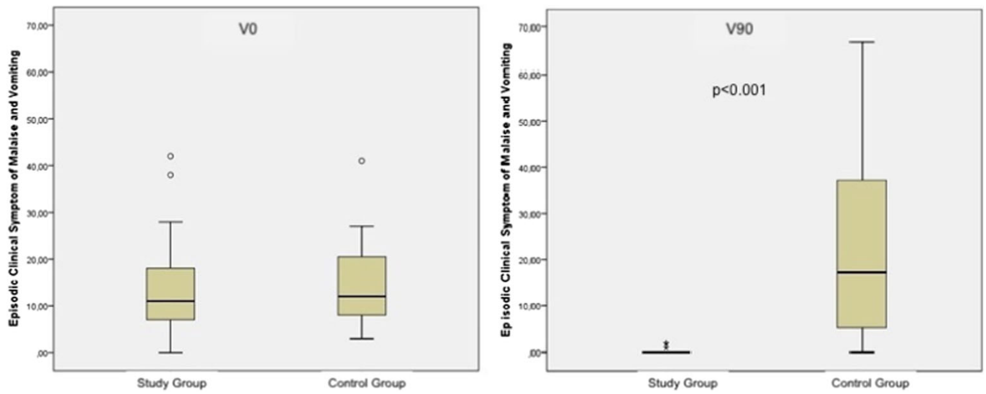

Figure 1 Episodic clinical symptoms

and solid for seven (43.8%) in the CG. At v90, for the SG group, the predominant food consistency was solid for 17 (94.4%) subjects, which is ideal for adults ($p = 0.043$) Table 5.

Regarding chewing, at v0, chewing was bilateral in eight (44.5%) subjects and unilateral in ten (55.5%) in the SG. For the CG, chewing was bilateral in four (25.0%) subjects and unilateral in 12 (75.5%). At v90, chewing was bilateral in 18 (100.0%) subjects in the SG ($p < 0.001$) Table 6.

At v0, the chewing capacity for the SG was great/good for nine (64.3%) subjects and regular for six (46.2%). In the CG, the chewing capacity was great/good for five (35.7%) subjects and regular for seven (53.8%). At v90, the chewing capacity was great/good for 18 (78.3%) subjects in the SG and great/good for seven (21.7%) subjects in the CG ($p = 0.002$) Table 7.

At v0, 13 (72.2%) subjects in the SG had no difficulty swallowing, and 12 (75.0%) in the CG did not report difficulty swallowing. At v90, 18 (100.0%) subjects in the SG and nine (56.3%) subjects in the CG did not report difficulty swallowing. Worsening of swallowing was observed for the subjects belonging to the CG ($p = 0.011$) Table 8.

Table 4 Less tolerated foods

Intolerance food (*n*, %)	V0			V90		
	Study group	Control group	*p*	Study group	Control group	*p*
Fruit	6 (33.3)	8 (50)	0.487	0 (0)	6 (37.5)	0.018
Leafy vegetables	7 (38.9)	3 (18.8)	0.270	0 (0)	5 (31.3)	0.043
Vegetables	6 (33.3)	3 (18.8)	0.448	0 (0)	7 (43.8)	0.007
Cereal	16 (88.9)	14 (87.5)	1.000	4 (25)	13 (81.3)	0.004
Bean	1 (5.6)	6 (37.5)	0.035	0 (0)	5 (31.3)	0.043
Meat	16 (88.9)	15 (93.8)	1.000	0 (0)	14 (87.5)	< 0.001
Milk and milk products	4 (22.2)	1 (6.3)	0.340	0 (0)	3 (18.8)	0.226

Discussion

The present study showed that the subjects of the SG, after speech therapy intervention, showed improvement in the consumption of fruits, leafy vegetables, vegetables, cereals, grains and meats; improvement in food consistency, with solid consistency foods prevailing; improvement in chewing type, which remained bilateral; improvement in chewing capacity and in swallowing; and improvement in episodic symptoms of food intolerance. No subjects in the study group presented recurrence during the period of the study, but no follow-up was performed after the study.

Equivalent postoperative times have been reported in studies of food intolerance in subjects undergoing bariatric surgery [10, 13, 14]. The most common clinical manifestations related to food intolerance reported in the scientific literature were vomiting (45%) in the first 6 months in 205 subjects [15]; nausea (76.5%), vomiting (63.6%) and abdominal pain (88.9%) in the first 6 months in 61 subjects; nausea (23.5%), vomiting (36.4%) and abdominal pain (11.1%) from 7 to 12 months [10]; and vomiting and dumping syndrome in 83.0% and 80.0%, respectively, of 70 subjects over a postoperative period greater than 12 months [16]. These symptoms may persist, as among 69 subjects 4 years after the Roux-en-Y gastric bypass procedure, 62% reported spontaneous vomiting and 27% induced vomiting [17]. The less tolerated foods reported include those with fibrous, dry, and greasy consistencies, such as meats, bread, rice, and raw vegetables [18, 19]. Intolerance to meat is expected due to the resection of a large part of the stomach, resulting in a change in the amount of

Table 5 Diet consistency evaluation

Diet predominant consistency evolution (*n*, %)	V0			V90		
	Study group	Control group	*p*	Study group	Control group	*p*
Liquids	3 (16.7)	2 (12.5)	0.814	0 (0.0)	3 (18.8)	0.043
Thickened paste	9 (50.0)	7 (43.8)		1 (5.6)	4 (25.0)	
Solids	6 (33.3)	7 (43.8)		17 (94.4)	9 (56.3)	

Table 6 Type of chewing

Chewing (*n*, %)	V0			V90		
	Study group	Control group	*p*	Study group	Control group	*p*
Bilateral	8 (44.5)	4 (25.0)	0.29	18 (100.0)	2 (12.5)	< 0.001
Unilateral	10 (55.5)	12 (75.0)		0 (0.0)	14 (87.5)	

pepsin production, which is an enzyme produced by the stomach that breaks down proteins. The intolerance to rice may result from the difficulty in digestion due to the process of hydration and gelatinization that it undergoes when cooked, which makes the work of the enzyme amylase difficult [20]. Food intolerance can also be explained by inefficient chewing, excessive food intake, and inadequate swallowing volume relative to the reduced gastric capacity or short intervals between meals [21–25]. The ingestion of insufficiently chewed food added to the swallowing of large volumes of air may lead to overload of mechanical activity in the stomach due to mixing of the poorly prepared food bolus [26]. The etiology leading to gastric hypertension of higher incidence is of exogenous origin. The excess gases accumulated in the stomach may be due to aerophagia or excessive swallowing of air, which is present mainly in anxious and tense patients. Eating with inappropriate or exaggerated opening of the mouth causes too much air to be swallowed; air can also be swallowed during speech, while opening the mouth improperly or while breathing with the mouth open [9, 27]. Speech therapy maintains concern and marked care in the process of dietary readaptation aimed at the functional process of chewing and swallowing so that the act of eating becomes pleasurable, healthy, and life-promoting in relation to the food intake and preference of solid foods, which is the typical pattern for adults. Higher consistency foods require greater exercise of the masticatory apparatus, whereas more pasty foods require less effort of the musculature [12, 28]. Lack of food cutting; fast masticatory rhythm; vertical jaw movements; large food bolus size; and short chewing time were observed in 40 morbidly obese patients submitted to gastroplasty, with significant changes relative to non-obese individuals [29]. Chewing is the most important function of the stomatognathic system, is the initial stage of the digestive process, and serves to measure the adequate amount of food to be ingested; during chewing, the body is prepared chemically for absorption of nutrients until the moment when it receives a sated appetite signal [30, 31]. The alternating bilateral chewing pattern is considered ideal because it stimulates the perioral membrane, masticatory muscles, and temporomandibular joints (TMJs) bilaterally, fixating the proprioceptive neuromuscular circuit and favoring occlusal stability. The way in which the teeth remain in contact during chewing is essential for the health and assistance of the stomatognathic system [27, 32]. Adequate chewing contributes to the prevention of myofunctional disorders, stimulating the orofacial muscles and favoring healthy development of the maxillary bones, to maintenance of the arches, to stability of occlusion and, finally, to muscular and functional balance. Its main function is the fragmentation of food into smaller and smaller particles, preparing the bolus for swallowing and digestion. The masticatory training allows the stimulation of lip seal, important for nasal breathing and adequate swallowing, favored by the efficient preparation of the bolus. The work of explaining and training with food through specific techniques of chewing and swallowing, added to the orientation of the relation of these functions, is relevant for the speech therapy goal [27, 30, 33, 34].

Table 7 Chewing capacity

Chewing capacity (*n*, %)	V0			V90		
	Study group	Control group	*p*	Study group	Control group	*p*
Great/good	9 (64.3)	5 (35.7)	0.535	18 (78.3)	7 (21.7)	0.002
Regular	6 (46.2)	7 (53.8)		0 (0.0)	3 (100.0)	
Bad/very bad	3 (42.9)	4 (57.1)		0 (0.0)	6 (100.0)	

Table 8 Swallowing difficulty

Swallowing difficulty (*n*, %)	V0			V90		
	Study group	Control group	*p*	Study group	Control group	*p*
No	13 (72.2)	12 (75.0)	0.569	18 (100.0)	9 (56.3)	0.011
At times	3 (16.7)	1 (6.3)		0 (0.0)	2 (12.5)	
Yes	2 (11.1)	3 (18.8)		0 (0.0)	5 (31.3)	

Beginning with the childhood pattern, swallowing acquires the adult pattern due to the change in the consistencies of the food offered, according to the food hierarchy—liquid, pasty, and solid. In speech therapy intervention, in the bariatric patient, this is the process followed during the postoperative period [28]. Swallowing is an orofacial function performed through a reflex sequence of ordered muscle contractions and integrated and complex neuromuscular activity. The mechanism used in swallowing is integrated and synchronized with the digestive and respiratory functions because the mouth and pharynx are chambers common for both processes. The intraoral content must be transferred to the pharynx, beginning its trajectory to the gastrointestinal tract, aiming at digestion and absorption in the intestinal mucosa [31, 35]. In relation to solid foods, swallowing is the final chewing phase and initial phase of the digestive process, where the oral content follows the four stages of food swallowing: preparatory phase: mechanical, involving the tongue, buccinator tone, with a voluntary reflex control duration < 0. 5"; oral phase: propulsion mechanics, tongue-tip mechanism, dorsal curl, glossopalatal sphincter opening, voluntary control, rhythmic pattern reflex, and participation of the jaw elevator, tongue, and genioglossus and palatal velum levator muscles, with a duration of 0.5"; pharyngeal phase: transport flow mechanics, increased pressure gradient, increased conductance, and duration of 0.8"; and esophageal phase: descending flow mechanics, pressure difference with control of peristalsis, and duration of 3.0 to 9.0" [27].

Speech therapy work in bariatric surgery occurs in the preparatory and oral phases, allowing better organization of the pharyngeal phase. It is clarified here that although the pharyngeal phase is involuntary, it is possible to improve it based on the work done in the oral phase and the masticatory training, which must proceed in a constant and conscious way. The functions of breathing, chewing, and swallowing and the close relationship between these functions are discussed. Even deglutition, not being the main problem, can lead to malfunctioning of breathing and chewing [12, 28, 31, 36].

This study found a significant improvement in the clinical symptoms of food intolerance in relation to food intake. The changes found may be explained by inadequate eating habits and chewing and swallowing patterns after Roux-en-Y gastric bypass [6, 28, 30, 35, 37–39]. Because it is a longitudinal study of high complexity, we consider this sample representative, since the results were expressive.

Conclusion

Speech therapy intervention in chewing led to a marked improvement of food acceptance and food intolerance resulting from Roux-en-Y gastric bypass.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval The study was approved by the Ethics and Research Committee registered in the Brazil Platform under opinion n. 438,600.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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