0021-7557/09/85-04/322
Jornal de Pediatria

Effects of conventional treatment of chronic functional constipation on total and segmental colonic and orocecal transit times

Ana Cristina Fontenele Soares,[1] Soraia Tahan,[1] Mauro Batista de Morais[2]

Abstract

Objective: To evaluate the effects of conventional treatment of chronic functional constipation on total and segmental colonic transit times and on orocecal transit time.

Methods: A total of 34 consecutive patients with functional constipation attending a specialized outpatient clinic were included in the study. Total and segmental colonic transit times were assessed using radiopaque markers. Hydrogen breath test was used to evaluate lactulose and bean orocecal transit times. Treatment consisted of disimpaction, general and dietary fiber intake instruction, and mineral oil administration.

Results: At admission, colonic dysmotility was found in 71.9% (23/32) of patients. All patients who complied with the treatment showed improvement of clinical symptoms after 6 weeks of treatment, when 82.6% (19/23) of those with dysmotility at admission returned to normal or reduced the severity of colonic transit patterns. Transit time decreased (medians) between admission and eighth week of treatment: lactulose orocecal transit (from 70 to 50 minutes, p = 0.002), bean orocecal transit (from 240 to 220 minutes, p = 0.002), and total colonic transit (from 69.5 to 37.0 hours, p = 0.001). The need for mineral oil therapy for constipation after a 12-month treatment was associated with persistence of total colonic transit higher than 62 hours at the eighth week of treatment (p = 0.014).

Conclusion: The conventional therapeutic approach yielded good results regardless of the presence or not of colonic dysmotility at inclusion in the study. Digestive tract motility abnormalities in functionally constipated children may be reversed, and may be secondary to constipation.

J Pediatr (Rio J). 2009;85(4):322-328: Gastrointestinal transit, constipation, therapy, pediatrics.

Introduction

The conventional treatment of chronic functional constipation involves, basically, the following procedures: fecal disimpaction and maintenance to prevent reimpaction using a high-fiber diet, instruction in the physiology of evacuation, and laxative therapy.[1,2]

In the etiology of chronic constipation, just as all functional diseases of the digestive tract, there is an interaction of biopsychosocial factors,[3] with an emphasis on the vicious circle of pain during defecation, leading to fecal retention, harder stools, and even more painful defecation.[1,3] It also involves constitutional factors, a low-fiber diet, and motility disorders of the digestive tract characterized by an increase in intestinal transit time, especially in the colon.[1,4,5]

1. Doutora, Disciplina de Gastroenterologia Pediátrica, Universidade Federal de São Paulo – Escola Paulista de Medicina (UNIFESP-EPM), São Paulo, SP, Brazil.
2. Professor associado, livre-docente, Disciplina de Gastroenterologia Pediátrica, UNIFESP-EPM, São Paulo, SP, Brazil. Chefe, Departamento de Pediatria, UNIFESP-EPM, São Paulo, SP, Brazil.

This study was conducted in the Discipline of Pediatric Gastroenterology, Universidade Federal de São Paulo – Escola Paulista de Medicina (UNIFESP-EPM), São Paulo, SP, Brazil.

No conflicts of interest declared concerning the publication of this article.

Suggested citation: Soares AC, Tahan S, de Morais MB. Effects of conventional treatment of chronic functional constipation on total and segmental colonic and orocecal transit times. J Pediatr (Rio J). 2009;85(4):322-328.

Manuscript submitted Dec 21 2008, accepted for publication Apr 23 2009.

doi:10.2223/JPED.1912

An increase in total colonic transit time is observed in about half of the patients with chronic constipation.[1,4-6] Among various patterns of colonic dysmotility, outlet obstruction[4,5] is traditionally considered the most frequent pattern; however, in our experience, an expressive number of patients shows delayed transit time in the right colon,[6,7] featuring colonic stasis. Little is known about the pathophysiological mechanisms involved in the genesis of colonic motility disorders.[1,8] Painful defecation episodes, as a trigger for constipation, are likely to lead to stool withholding maneuvers which result in lumpy and hard stools. This process, over time, may cause rectal and sigmoid distension due to fecal continence.[8]

Hypothetically, distension of the colonic wall may compromise its contraction and propulsive force, or even be accompanied by the absence of high-amplitude peristaltic colonic waves, which propel stool toward the rectum. This situation has been described in children with severe refractory constipation, in whom colonic manometry did not reveal high-amplitude peristaltic colonic waves, even after stimulation of a meal (gastrocolic reflex) or administration of a peristaltic stimulant.[9] Theoretically, fecaloma emptying and maintenance treatment could also be accompanied by a reduction in colon size with recovery of contraction force. These processes could affect colonic transit time. Classic studies with healthy adult women showed that inflation of rectal balloon or voluntary suppression of defecation lead to delayed gastric emptying, which is called cologastric brake.[10,11] In children, using the hydrogen breath test after a bean test meal, we demonstrated delayed orocecal transit time in chronic functional constipation with increased total colonic transit time.[6] Thus, rectal fecal impaction may cause disorders secondary to colonic motility, gastric emptying, and small bowel transit. Only a few articles have analyzed the evolution of the colonic transit time during conventional treatment of chronic constipation, some of them focusing on the effect of dietary fibers or prokinetic drugs on transit time.[12-16]

Therefore, the objective of the present study is to analyze the effects of conventional treatment of chronic functional constipation in patients attending a referral outpatient clinic on clinical symptoms, total and segmental colonic transit times, and lactulose and bean test meal orocecal transit times.

Patients and methods

Patients

The sample was composed of 34 patients with clinical diagnosis of chronic functional constipation, consecutively admitted to the Constipation Clinic of the Discipline of Pediatric Gastroenterology, Universidade Federal de São Paulo – Escola Paulista de Medicina (UNIFESP-EPM), São Paulo, southeastern Brazil. Patients unable to perform voluntary collection of air samples for the hydrogen breath test, using antibiotics in the 4 weeks prior to examination, with constipation secondary to Hirschsprung's disease, spinal or anal anomalies, metabolic diseases, and cerebral palsy were excluded from the study.

Chronic constipation was characterized by hard stools that were painful or difficult to pass, associated or not with longer intervals between evacuations, blood mixed with stools, fecal retention, and soiling for over a 3-month period.[1,6,7,13] When necessary, anorectal manometry was performed, as well as additional examinations, to rule out other non-functional causes of chronic constipation as recommended.[1,2,17]

Study design

In this prospective cases series of patients with chronic functional constipation, we assessed lactulose and bean test meal orocecal intestinal transit times (5-day interval between each test), oroanal transit time of carmine dye, and total and segmental colonic transit times with radiopaque markers. These measurements were conducted at admission (before treatment started) and at the sixth week of treatment.

At month 12, after mineral oil was discontinued for at least 15 days, we reassessed bean test meal orocecal transit time and oroanal transit time of carmine dye.

Methods

Clinical information and data collection

An individual standardized form including the following clinical parameters was used: defecation frequency, pain during defecation, fear or effort during defecation, fecal retention, stool consistency and shape, presence of soiling, blood mixed with stools, and abdominal distension and pain. A complete physical examination, including a rectal examination, was also performed.

Follow-up appointments were conducted every 2 weeks to collect relevant clinical information. In addition, a physical examination focusing on fecal impaction was performed. All assessments were carried out by the same investigator (A.C.F.S.).

Therapy regimen

At inclusion in the study, when necessary, disimpaction was performed with phosphate enema for 2 to 5 days. Patients were then prescribed a high-fiber diet and mineral oil at a dose of 1-3 mL/kg/day, in two divided doses. General instruction in the physiology of evacuation and bowel training including defecation in the toilet after meals were also part of the therapy regimen. At follow-up appointments, when necessary, mineral oil dose was adjusted. In the case of reimpaction, disimpaction procedures were repeated.[1,18]

Hydrogen breath test to assess orocecal transit time

The hydrogen breath test was used to assess orocecal transit time after ingestion of lactulose and a test meal of cooked beans.

Tests were performed after a 12-hour fast. Before examinations, oral cleaning was performed with 0.05% chlorhexidine. Stools were collected and breath hydrogen concentration was determined, respectively, using the GaSample system and a model 12i Quintron Microlyser gas chromatograph, both purchased from Quintron Instrument Co. Inc. (Menomonee Falls, Wisconsin, USA).[6,7]

Orocecal transit time was defined as the time between the ingestion of lactulose or beans and a rise of 10 ppm in baseline breath hydrogen concentration, in each of two consecutive samples.[5]

To assess lactulose orocecal transit time, after collecting baseline fasting samples of end-expired air, a 10-g 10% dilute lactulose solution was administered orally. After the ingestion of lactulose, serial 10-minute samples of end-expired air were collected for 180 minutes (end of the test). Cases in which a minimum 10-ppm rise was not achieved in the fasting breath hydrogen concentration, the test was extended to 240 minutes.[6]

The child was defined as not producing hydrogen when peak hydrogen in exhaled air was lower than 10 ppm in relation to baseline in samples collected until 240 minutes in the lactulose breath test.[5]

Total and segmental colonic transit times

Total and segmental colonic transit times were assessed using radiopaque markers, according to the technique described by Metcalf et al.[19] For this examination, three capsules with 24 radiopaque markers of three distinctive types were used, as described previously in sufficient detail.[6,7] Each child ingested one capsule with 24 markers on three consecutive mornings. On the fourth day, a plain anteroposterior abdominal radiograph was performed. An additional radiograph was performed at day 7 if more than 80% of the markers remained in the previous film. Radiographs were performed using high-sensitivity and high-kilovoltage films, allowing a reduction in radiation dose of approximately 1/4 in relation to conventional radiographs.

Total and segmental colonic transit times were calculated according to a previously described formula.[19] The patterns of colonic motility disorder were defined according to the following criteria[20-22]:

- Outlet obstruction: delayed rectosigmoid transit time;
- Distal obstruction: delayed left colonic transit time associated or not with delayed rectosigmoid transit time;
- Right colonic stasis: delayed right colonic transit time associated or not with delayed left colonic and rectosigmoid transit times;
- Normal colonic transit: normal colonic transit in the three segments.

The upper limits of the normal range for right colon, left colon, and rectosigmoid total colonic transit time were, respectively, 62, 18, 20, and 34 hours.[19]

Oroanal transit time of carmine

Children were given 500 mg oral carmine diluted in 50 mL water. Mothers were instructed to write down the date and time when the stools changed color. Oroanal transit time was defined as the time between the ingestion of carmine dye and its initial appearance with stools.[23]

Statistical analysis

Statistical calculations were conducted using the Jandel Sigma Stat software. In all cases, the level of rejection for null hypothesis was set at a p value less than or equal to 0.05 (5.0%). The several tests used are specified along with the results. Median and 25th and 75th percentiles (shown in parentheses) were used to express those variables with non-normal distribution. The other variables were expressed as mean and standard deviation.

The project was analyzed and approved by the Research Ethics Committee of UNIFESP-EPM. Written and signed informed consent was obtained from children's guardians and from those children aged over 12 years.

Results

A total of 34 patients with median age (25th and 75th percentiles) of 93.7 (74.3-107.4) months were included in the study, minimum age of 3 and maximum of 13 years. Regarding sex, 19 were boys and 15 were girls. Median age at onset of constipation was 12 (4 and 48) months. In 15 (44.1%) of 34 patients, first symptoms occurred during the first year of life, in six (40.0%) of these 15 patients occurring during the first 6 months of life. Soiling was found in 29 (85.3%) of 34 patients. Median age at onset of soiling was 60 (48 and 68) months. Soiling starting before 48 months of age occurred in nine (31.0%) of 29 patients. These nine patients had already learned sphincter control before the onset of soiling. Median soiling frequency was 7 (3 and 7) days per week, i.e., most patients presented daily soiling. Of the 34 patients admitted, only one did not attend follow-up clinical and transit time reassessment at the eighth week of treatment, since the family moved to another city.

Table 1 shows clinical characteristics of 33 patients reassessed at the sixth week of treatment. At the sixth week of treatment, 30 (90.9%) of 33 patients were asymptomatic. Of the remaining three symptomatic

patients, one patient showed persistence of soiling, pain and effort during defecation; one patient showed pain during defecation; and another patient showed fear of defecation. Statistical analysis revealed statistically significant reduction in all clinical manifestations of constipation in relation to baseline assessment. A statistically significant increase was observed in the number of weekly defecations.

Table 2 shows orocecal transit times after lactulose administration and after a bean test meal at admission and at the sixth week of treatment. Statistical analysis revealed statistically significant reduction in both lactulose and bean orocecal transit times. A statistically significant reduction was also observed in oroanal transit time and total and segmental colonic transit times. It is worth mentioning that all patients analyzed both at admission and at the sixth week of treatment and after a 1-year treatment were hydrogen producers.

Taking into account the 64 measurements of oroanal carmine and total colonic transit times with radiopaque markers, Sperman's correlation coefficient was calculated, being equal to +0.87 ($p < 0.001$).

Two of 34 patients included in the study were not reassessed for total and segmental colonic transit times at the sixth week (one moved to another city, and the other did not undergo these examinations but continued with treatment and follow-up). Regarding the pattern of colonic motility disorder at the sixth week of treatment, 22 (68.7%) of 32 patients showed normal transit time in the three segments. In the remaining patients: three (9.4%) showed right colonic stasis, three (9.4%) showed distal obstruction, and four (12.5%) showed outlet obstruction, as described in Table 3.

When possible, patients with chronic functional constipation were reassessed 6 and 12 months after admission to the study.

At month 6, a clinical reassessment was performed in 33 of the 34 initial study patients. Of these 33 patients, 28 (84.8%) were asymptomatic. Five (15.2%), despite

Table 1 - Clinical characteristics of 33 patients with chronic functional constipation at admission and at the sixth week of treatment

Characteristics	Admission, n (%)	Sixth week, n (%)	p*
Effort during defecation	32 (97.0)	2 (6.0)	0.001
Pain during defecation	32 (97.0)	2 (6.0)	0.001
Abdominal pain	29 (87.9)	5 (15.1)	0.001
Soiling	28 (84.4)	1 (3.0)	0.001
Fear of defecation	15 (45.5)	1 (3.0)	0.001
Fecal retention	13 (39.4)	1 (3.0)	0.001
Less than three defecations per week	25 (75.7)	1 (3.0)	0.001
Defecation frequency per week	1.0 (1.0-2.0)†	6.0 (5.0-6.0)†	0.001‡

* McNemar test.
† Median and 25th and 75th percentiles.
‡ Wilcoxon test.

Table 2 - Total and segmental orocecal, oroanal, and colonic transit times of patients (n = 33) with chronic functional constipation at admission and at the sixth week of treatment

Transit time	Admission	Sixth week	p
Orocecal			
Lactulose (minutes)	70 (50-70)	50 (48-60)	0.002
Beans (minutes)	240 (220-260)	220 (200-240)	0.002
Oroanal			
Carmine (hours)	62.0 (46.7-120.0)	30.0 (24.0-45.2)	0.001
Colonic			
Right colon (hours)	13.0 (6.5-27.0)	11.0 (5.5-18.5)	0.001
Left colon (hours)	27.5 (12.5-41.0)	9.5 (15.5-25.5)	0.001
Rectosigmoid (hours)	28.5 (19.0-40.0)	9.5 (15.5-25.5)	0.001
Total colonic (hours)	69.5 (52.5-104.5)	37.0 (27-51.5)	0.001

Values expressed as median and 25th and 75th percentiles in parentheses, Wilcoxon test.

regular use of mineral oil, needed one or two rectal enemas for fecal disimpaction after maintenance treatment had started. At this assessment, only six (18.1%) patients did not need mineral oil to maintain a positive bowel habit.

At month 12, 24 (72.7%) of 33 patients remained on follow-up. Of these 24 patients, 22 (91.6%) were asymptomatic. Two (8.3%) needed intestinal lavage when mineral oil was discontinued. After reintroduction of the laxative, positive bowel habit was reinstated. Of the 24 patients, 12 (50.0%) continued on mineral oil. Of these 12 patients, 10 (83.3%) had shown total colonic transit time higher than 62 hours before treatment started, whereas six (50.0%) of the 12 who did not need mineral oil showed total colonic transit time higher than 62 hours ($p = 0.193$, two-tailed Fisher's exact test). At the sixth week of treatment, the 12 (100%) who did not need mineral oil at month 12 showed total colonic transit time lower than 62 hours, whereas, of the 12 who still needed mineral oil at month 12, only six showed normal total colonic transit time lower than 62 hours at the sixth week of treatment ($p = 0.014$, two-tailed Fisher's exact test).

Of the 24 patients, 17 (70.8%) agreed to repeat, at month 12, orocecal transit time with bean test meal and oroanal transit time (carmine). Table 4 shows orocecal and oroanal transit times of these 17 patients at admission, at the sixth week of treatment and after a 12-month follow-up period. It is important to point out that, prior to the assessments at 12 months, administration of laxative was discontinued in all patients for at least 15 days.

Discussion

At the sixth week of treatment, including mineral oil administration, we observed a statistically significant reduction in lactulose and bean test meal orocecal transit times, in oroanal transit time of carmine, and in total colonic transit time measured with radiopaque markers (Table 2). We also observed changes in the patterns of colonic dysmotility toward normal patterns or exclusive involvement of distal colonic portions (Table 3). At this time point, almost all patients showed positive clinical response, indicating that dysmotility patterns at admission are not predictive of outcome at the initial phase of treatment, even for those patients who showed right colon stasis. Decreased transit is likely to have resulted from cessation of fecal retention and fecaloma emptying, neutralizing the phrenocolonic reductive effect on the proximal motility of the digestive tube.[8,11,12] Only one study analyzed orocecal transit time during treatment and did not show its reduction,[24] in opposition to our data, which showed a decrease in this parameter using both lactulose and bean test meal. It is worth mentioning that dysmotility of the proximal digestive tube may be associated with symptoms in the upper abdomen, such as early saciety, which may disappear after fecaloma emptying.[6,8,10,12]

Regarding total and segmental colonic transit times, it is difficult to compare our results with the few studies found in the literature, considering that distinct therapy regimens[14,16,24,25] or patients with constipation associated with neurological involvement were analyzed.[15] Regarding our patients with clinical symptoms improved upon

Table 3 - Pattern of colonic motility disorder of patients with chronic functional constipation at admission and at the sixth week of treatment

Admission	n (%)	Sixth week	n
Normal	9 (28.1)	Normal	9
Right colonic stasis	11 (34.4)	Normal	5
		Right colonic stasis	2
		Distal obstruction	3
		Outlet obstruction	1
Distal obstruction	10 (31.3)	Normal	7
		Right colonic stasis	1
		Outlet obstruction	2
Outlet obstruction	2 (6.3)	Normal in the three segments	1
		Outlet obstruction	1

Sixth week: normal, n = 22 (68.8%); right colonic stasis, n = 3 (9.4%); distal obstruction, n = 5 (15.6%); outlet obstruction, n = 4 (12.5%).

Table 4 - Bean test meal orocecal transit time and oroanal transit time at admission and at 6-week and 1-year clinical follow-ups in patients (n = 17) with chronic functional constipation

Transit time	Admission	Six weeks	12 months	p
Bean orocecal (minutes)	240.0 (215.0-240.0)	220.0 (200.0-245.0)*	200.0 (180.0-230.0)*	0.006
Carmine oroanal (hours)	62.0 (46.8-202.5)	30.0 (23.0-44.5)	30.0 (24.0-49.0)	0.001

Median and 25th and 75th percentiles in parentheses, Friedman test with Dunn multiple-comparison test.
* $p < 0.05$.

prescription of therapy regimen, one can speculate that a reduction in colonic dimensions may have occurred, which could have contributed to returning to a normal peristaltic function. This hypothesis cannot be confirmed in practice due to ethical restrictions inherent to colon-contrasted serial radiographs to demonstrate reduction in its dimensions. Within this context, in the group of 17 patients who agreed to repeat the measurement of carmine oroanal transit time after one year of treatment, mineral oil discontinued for at least 2 weeks, median time remained at 30 hours as observed since the sixth week of treatment, pointing out a high correlation (r = +0.89) between total and oroanal colonic transit time of carmine. These results could be interpreted as suggesting, in children, that colonic motility abnormalities of functional constipation might be reversed, even after cessation of laxatives, that is, they are secondary to constipation.

Our data also show a higher probability of laxative need after 1 year of treatment in patients with persistence of delayed total colonic transit time at the sixth week of treatment, underscoring the importance of the initial phase of treatment. In Dutch children with functional constipation treated with a therapy regimen similar to that used in the present study, the authors observed that a negative evolution after 1 year of treatment was associated with a total colonic transit time higher than 100 hours.[12] In our study, we observed that, at admission, nine (28.4%) of the 34 patients showed total colonic transit time higher than 100 hours (data not shown). After a 12-month follow-up period, six of these nine patients remained on mineral oil, confirming that a total colonic transit time higher than 100 hours at baseline assessment may be an indicator of a worse prognosis. We should highlight that, due to the small number of patients, no statistically significant association was obtained. Thus, in our opinion, the main limiting factor of our study lies in the lack of possibility to repeat baseline assessments after a 1-year follow-up, which is common in clinical studies in which some patients are expected to withdraw treatment protocol, especially those fully recovered. Another aspect refers to patient severity, that is, the results from the present study cannot be extrapolated to all functionally constipated children, especially to those with less severe functional constipation who do not attend specialized clinics.[12,26-28]

Of the patients followed for up to 1 year after treatment, half of them still needed mineral oil to maintain an adequate bowel habit, which is consistent with the scarce information found in the literature concerning improvement of clinical symptoms of constipated patients followed for at least 1 year in specialized clinics.

In conclusion, the conventional therapeutic approach yielded good results regardless of the presence or not of colonic dysmotility at inclusion in the study. The persistence of delayed total colonic transit time at the sixth week of treatment indicates a higher probability of laxative need after 1 year of treatment. Digestive tract motility abnormalities in functionally constipated children may be reversed, and may be secondary to constipation.

References

1. Morais MB, Maffei HV. Constipação intestinal. J Pediatr (Rio de J). 2000;76:S147-S156.
2. North American Society for Pediatric Gastroenterology, Hepatology and Nutrition. Evaluation and treatment of constipation in children: summary of updated recommendations of the North American Society for Pediatric Gastroenterology, Hepatology and Nutrition. J Pediatr Gastroenterol Nutr. 2006;43:405-7.
3. Drossman DA. The functional gastrointestinal disorders and the Rome III process. Gastroenterology. 2006;130:1377-90.
4. Benninga MA, Buller HA, Staalman CR, Gubler FM, Bossuyt PM, van der Plas RN et al. Defecation disorders in children, colonic transit time versus the Barr-score. Eur J Pediatr. 1995;154:277-84.
5. Benninga MA, Buller HA, Tytgat GN, Akkermans LM, Bossuyt PM, Taminiau JA. Colonic transit time in constipated children: does pediatric slow-transit constipation exist? J Pediatr Gastroenterol Nutr. 1996;23:241-51.
6. Soares AC, Lederman HM, Fagundes-Neto U, de Morais MB. Breath hydrogen test after a bean meal demonstrates delayed oro-cecal transit time in children with chronic constipation. J Pediatr Gastroenterol Nutr. 2005;41:221-4.

7. Soares AC, Lederman HM, Fagundes-Neto U, de Morais MB. Breath methane associated with slow colonic transit time in children with chronic constipation. J Clin Gastroenterol. 2005;39:512-5.
8. Benninga MA, Voskuijl WP, Taminiau JA. Childhood constipation: is there a new light in the tunnel? J Pediatr Gastroenterol Nutr. 2004;39:448-64.
9. Villarreal J, Sood M, Zangen T, Flores A, Michel R, Reddy N, et al. Colonic diversion for intractable constipation in children: colonic manometry helps guide clinical decisions. J Pediatr Gastroenterol Nutr. 2001;33:588-91.
10. Kellow JE, Gill RC, Wingate DL. Modulation of human upper gastrointestinal motility by rectal distension. Gut. 1987;28:864-8.
11. Tjeerdsma HC, Smout AJ, Akkermans LM. Voluntary suppression of defecation delays gastric emptying. Dig Dis Sci. 1993;38:832-6.
12. de Lorijn F, van Wijk MP, Reitsma JB, van Ginkel R, Taminiau JA, Benninga MA. Prognosis of constipation: clinical factors and colonic transit time. Arch Dis Child. 2004; 89:723-7.
13. Mooren GC, van der Plas RN, Bossuyt PM, Taminiau JA, Buller HA. The relationship between intake of dietary fiber and chronic constipation in children. Ned Tijdschr Geneeskd. 1996;140:2036-9.
14. Nurko S, Garcia-Aranda JA, Worona LB, Zlochisty O. Cisapride for the treatment of constipation in children: a double-blind study. J Pediatr. 2000;136:35-40.
15. Staiano A, Simeone D, Del Giudice E, Miele E, Tozzi A, Toraldo C. Effect of the dietary fiber glucomannan on chronic constipation in neurologically impaired children. J Pediatr. 2000;136:41-5.
16. Castillejo G, Bulló M, Anguera A, Escribano J, Salas-Salvadó J. A controlled, randomized, double-blind trial to evaluate the effect of a supplement of cocoa husk that is rich in dietary fiber on colonic transit in constipated pediatric patients. Pediatrics. 2006;118: e641-8.
17. Hyams J, Colletti R, Faure C, Gabriel-Martinez E, Maffei HV, Morais MB, et al. Functional gastrointestinal disorders: Working Group Report of the First World Congress of Pediatric Gastroenterology, Hepatology, and Nutrition. J Pediatr Gastroenterol Nutr. 2002;35 Suppl 2:S110-7.
18. Baker SS, Liptak GS, Colletti RB, Croffie JM, Di Lorenzo C, Ector W, Nurko S. Constipation in infants and children: evaluation and treatment. A medical position statement of the North American Society for Pediatric Gastroenterology and Nutrition. J Pediatr Gastroenterol Nutr. 1999;29:612-26.
19. Metcalf AM, Phillips SF, Zinsmeister AR, MacCarty RL, Beart RW, Wolff BG. Simplified assessment of segmental colonic transit. Gastroenterology. 1987;92:40-7.
20. Arhan P, Devroede G, Jehannin B, Lanza M, Faverdin C, Dornic C, et al. Segmental colonic transit time. Dis Colon Rectum. 1981;24:625-9.
21. Devroede G. Constipation. In: Sleizenger MH, Fordtran, JS, editors. Gastrointestinal Disease. 5th ed. Montreal: Saunders; 1993. p. 837-87.
22. Guimarães EV. Tempo de trânsito colônico em crianças com constipação intestinal crônica funcional: comparação entre métodos de interpretação radiológica [tese]. Belo Horizonte: Universidade Federal de Minas Gerais; 1999.
23. Dimson SB. Carmine as an index of transit time in children with simple constipation. Arch Dis Child. 1970;45:232-5.
24. Odeka EB, Sagher F, Miller V, Doig C. Use of cisapride in treatment of constipation in children. J Pediatr Gastroenterol Nutr. 1997;25:199-203.
25. Halabi IM. Cisapride in management of crhonic pediatric constipation. J Pediatr Gastroenterol Nutr. 1999;28:199-202.
26. Clayden GS, Lawson JO. Investigation and management of long-standing chronic constipation in childhood. Arch Dis Child. 1976;51:918-23.
27. Nolan TM, Debelle G, Oberklaid F, Coffey C. Randomised trial of laxatives in treatment of childhood encopresis. Lancet. 1991;338:523-7.
28. Loening-Baucke V. Clinical approach to fecal soiling in children. Clin Pediatr (Phila). 2000;39:603-7.

Correspondence:
Mauro Batista de Morais
Rua Pedro de Toledo, 441
CEP 04039-031 - São Paulo, SP - Brazil
Tel.: +55 (11) 5576.4144, +55 (11) 5576.4148
Fax: +55 (11) 5570.5834
E-mail: mbmorais@osite.com.br