

Factors determining outcome in children with chronic constipation and faecal soiling

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SUMMARY To evaluate factors which might contribute to treatment failure in children with chronic constipation and soiling, we evaluated the history, physical findings, defecation dynamics, and anorectal function in 97 patients. We treated them with milk of magnesia, high fibre diet, and bowel training techniques and evaluated outcome at one year when 43% had recovered. Recovery rates were similar for boys and girls. Fifty seven per cent of the patients had not recovered. This group at the outset had more frequent soiling episodes, more severe constipation, were less likely to defecate water filled rectal balloons and to relax the external sphincter during defecation. In general girls had more severe constipation, abdominal pain, and a previous urinary tract infection than boys. Girls were more compliant during treatment and had less frequent soiling episodes at one year. Stepwise logistic regression showed that severe constipation, abnormal contraction of the external sphincter and pelvic floor during attempted defecation, and inability to defecate the 100 ml balloon in ≤ 1 min was significantly related to treatment failure. Defecation of smaller balloons, volumes for threshold of rectal sensation, critical volume and rectal contraction, and compliance with treatment could not predict treatment failure.

The common clinical history of children with chronic constipation and faecal soiling (overflow incontinence) includes a prolonged period, often of many years duration, of infrequency and abnormal stools. The frequency of soiling can range from several times a week to more than 10 times a day. At the time of diagnosis, most children present with a very large amount of stool in a dilated rectal ampulla. Approximately 40% of our patients have an abdominal faecal mass present, a physical finding which indicates a severe form of constipation.¹

Treatment programmes for the majority of children with chronic constipation and soiling have included maintenance of bowel cleanout by either oral or rectal medication and strict attention to diet and toilet use. Strict attention to bowel cleanout will prevent faecal soiling but approximately half of these

children remain chronically constipated if they do not receive frequent doses of laxatives for many years.²⁻⁷

Several anorectal manometric abnormalities have been described in patients with chronic constipation and soiling: decreased ability of the internal sphincter to relax during rectal distension;^{4,5,8-10} abnormalities in rectal and sigmoidal sensation;^{4,11} a weak abdominal muscle contraction during defecation;¹² and more recently, an abnormal contraction of the external anal sphincter during defecation.^{1,13-15} Treatment resistance was thought to be caused by non-compliance,³ low social background which was associated with non-compliance,¹⁶ behavioural problems, and abnormal manometric findings.

In this study we further evaluated the relationship of factors which are thought to contribute to treatment failure such as severe constipation, external sphincter contraction during defecation attempts, inability to defecate balloons, blunted rectal sensation, decreased ability of the internal anal sphincter to relax during rectal distension, and compliance with a treatment programme.

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Methods

STUDY POPULATION

The study population consisted of 97 consecutive patients (69 boys) 5.0 to 14.5 years of age, mean 9.0 (2.4) years, with chronic constipation and overflow incontinence. These children had their initial evaluation between January 1985 and December 1986. All constipated children had abnormal stools for more than one year. Some of the patients defecated small amounts of stool daily or several times daily into the toilet but stool evacuation was incomplete as evidenced by periodic passage of very large amounts of stools (every 7–30 days), often clogging the toilet. In an occasional child no large stools had been noted, except during the initial evaluation after enemas were used for disimpaction. The frequency of soiling ranged from once a week, to >10 times a day, mean frequency 15 per week. At the time of the initial evaluation all constipated children had a very large amount of stool present in the rectal ampulla, and 33% of the boys and 79% of the girls had a palpable faecal mass present in the abdomen. The abdominal faecal mass indicated severe constipation and was felt most often suprapubic and midline extending up to the umbilicus (megacolon/megarectum syndrome). Occasionally the faecal mass was distending the whole abdomen. Patients who had no palpable abdominal mass were considered to have mild constipation. Many patients had previously received stool softeners, laxatives, suppositories or enemas but had not recovered. All medications were discontinued at least one week before the first evaluation.

During the study period we evaluated seven additional patients (five boys, two girls) who fitted the criteria. They were excluded because we could not retrieve them for follow up. These seven patients were seven to 14.9 years old, and three had an abdominal faecal mass present on the initial evaluation. Their age and frequency of severe constipation were similar to the study group. Children less than five years of age and those with hypothyroidism, Hirschsprung's disease, mental deficiency, chronic debilitating disease, or previous colon surgery were excluded from the study.

Sixteen healthy children (11 boys, five girls) aged 6.5 to 12.8 years, mean age 10.3, who had been studied previously¹ served as controls. These control children were children of the staff of the University of Iowa who volunteered for this study. They had from two bowel movements per day to one every other day. They had no history of previous gastrointestinal tract disease, and their physical examinations were normal.

The study was approved by the Institutional

Human Research Review Committee. Written informed consent was obtained from the parents and children studied.

STUDY PROTOCOL

During the initial visit a complete history was taken, including details of any gastrointestinal or urinary symptoms, and a physical examination, and anorectal studies were performed. The evaluations of balloon defecations and anorectal manometric and electrophysiologic studies were performed at least one hour after disimpaction with one to two phosphate enemas. In children with enormous faecal retention, disimpaction was done over several days and the child returned after disimpaction for testing. Subsequently, the 97 constipated children received treatment consisting of milk of magnesia (1–2 ml/kg body weight daily, as necessary to induce one to two bowel movements per day and prevent soiling), a high fibre diet, and instructions in bowel training techniques including regular use of the toilet at least twice daily after meals with monitoring of bowel movements and soiling episodes. Parents and children were instructed and encouraged to increase intake of high fibre or bran containing cereals and breads, fruits, and vegetables. Treatment included efforts to alleviate guilt by explaining to the parents and children the apparent pathophysiologic abnormalities causing or adding to the constipation and faecal soiling and using positive reinforcement with rewards when necessary.

Patients were initially evaluated monthly to review stool frequency and soiling, and to check for reaccumulation of stool in the abdomen and rectum. The milk of magnesia dosage was adjusted if necessary. The patients were followed up every three months. Follow up evaluation was carried out by a mailed questionnaire 12 months after treatment began and parents were asked to rate the last month. Data obtained were frequency of defecation, frequency and amount of soiling and urinary incontinence, presence of abdominal pain, and if and how often medication was used to treat constipation or soiling. As previously^{1,4,5} recovery from constipation and faecal soiling was defined as ≥ 3 bowel movements/week and minimal (≤ 2 smears/month) or no soiling while off laxatives for at least one month.

STUDIES OF BALLOON DEFECATION

To simulate defecation of a stool from the rectum, children were asked to defecate rectal balloons filled with 30, 50, and 100 ml water, respectively, allowing five minutes for each balloon, while sitting on a toilet chair. Balloon defecation for each size balloon was evaluated during the first minute and during five minutes. The intra-abdominal pressure exerted onto

the rectal balloon during attempts to defecate was transmitted via a polyethylene tube to a pressure transducer (type 4-327-0, Beckman Instruments, Fullerton, CA) and recorded with an eight-channel dynograph recorder (Beckman R-611, SensorMedics, Anaheim, California, USA). The strongest and longest pressure changes were evaluated.

STUDIES OF THE EXTERNAL SPHINCTER AND PELVIC FLOOR DURING THE ACT OF BEARING DOWN FOR DEFECACTION

Myoelectrical activity from the external sphincter was recorded at a speed of 10 mm/sec with three surface electrodes (Andover Medical Supply, Bloomington, MN). Two electrodes were placed over the external sphincter, and a third on the buttock. The area under the wave form of the action potentials, an index of total activity, was obtained by integrating the primary signals with an EMG averaging coupler (SensorMedics, Type 9852A, Anaheim, California, USA). Simultaneously, we performed anorectal manometry with a motility probe (Model P31-D3, Sandhill Scientific, Littleton, Colorado, USA) to evaluate the combined function of the external and internal anal sphincters and rectal pressure changes. The instrument has been described previously.^{4,8} One of the transducers was placed into the rectum (6 cm), and a second into the anal canal (1 cm above the anal verge). A latex balloon (2.5 × 3 cm) tied to the end of a polyethylene tube was used for rectal distension and placed with its base 11 cm above the anal verge. The outputs of all transducers and surface electrodes were fed into amplifiers of the recorder and graphed on paper.

While lying in the left lateral position the child was asked to bear down five times as if defecating and to squeeze (tighten up) five times in random order. We defined the act of bearing down for defecation as normal if the integrated EMG decreased during intra-abdominal pressure increase (rectal pressure recording ≥ 30 mmHg) during at least two of five defecation trials. We defined defecation as abnormal if there was a persistent increase in the integrated EMG during bearing down (with intra-abdominal pressure increase ≥ 30 mmHg) in at least four of the five defecation trials. Absence of changes in the integrated EMG during a defecation trial was regarded as no change in EMG.

STUDIES OF THE EFFECTS OF RECTAL DISTENSION

Because it is possible that children with chronic constipation who do not recover have significantly more impairment in anorectal function than children who recover, we evaluated the response of the

rectum and anus to rectal distension. These tests have been described previously to require significantly higher balloon volumes in the constipated children as compared with controls.^{4,8} With the base of the balloon 11 cm above the anal verge we determined: the minimal amounts of air (ml) required to elicit a transient sensation of rectal balloon distension and the threshold of the rectosphincteric reflex (≥ 5 mmHg relaxation of anal tone) by inflating the balloon two to three times transiently with volumes between 60 and 5 ml in random order, starting each time at 0 ml;⁸ the minimal amount of air required to produce a lasting urge (30 seconds) to defecate (critical volume), a sustained complete relaxation of the internal and external sphincters (constant relaxation), and a rectal contraction of ≥ 10 mmHg, by stepwise adding initially 10 ml air up to 60 ml and then 30 ml each 20–30 seconds into the rectal balloon.⁴ When the critical volume had been reached, but constant relaxation or rectal contraction of ≥ 10 mmHg had not occurred the next higher volume was used as the volumes of constant relaxation and rectal contraction.

COMPLIANCE WITH TREATMENT

We evaluated non-compliance because treatment resistance is thought to be the result of non-compliance.³ Parents and children were instructed to reduce the milk of magnesia dosage to the lowest dose or even discontinue as long as at least one bowel movement every other day was produced and no soiling occurred. Parents and children were counted as not compliant if they had discontinued laxative use or did not increase dosage as suggested in spite of continued soiling or recurrence of soiling at one year.

STATISTICAL ANALYSIS

Statistical methods included stepwise logistic regression procedure,¹⁷ the Wilcoxon's non-paired rank-sum test and signed rank-sum test, and Fisher's exact probability test with significance accepted at 5% level. Results were expressed as mean (SD).

Results

Forty three per cent of patients (33 boys, nine girls) had recovered at 12 months while 57% of patients (36 boys, 19 girls) had not. Recovery rates in boys were similar to those in girls ($p=0.18$). The mean ages in the recovered patients (9.1 (2.3) years) and the non-recovered patients (9.0 (2.4) years) were similar.

GASTROINTESTINAL SYMPTOMS

Constipated patients differed in their ability to recover by one year from chronic constipation and overflow incontinence. As can be seen in Table 1,

Table 1 Findings in the initial history and physical examination

	Constipated children		
	Recovered n=42	Non- recovered n=55	p Value*
Bowel movements/week	5 (4)	4 (5)	NS
Soiling episodes/week	10 (11)	18 (17)	<0.002
Abdominal pain (%)	49	44	NS
Presence of abdominal faecal mass (%)	26	62	<0.0006
Nighttime urinary incontinence (%)	37	40	NS
Previous urinary tract infection (%)	8	20	NS

Results are expressed as mean (SD); *Fisher's exact test or Wilcoxon's non-paired rank-sum test.

patients with severe constipation (abdominal faecal mass present on initial evaluation) were less likely to recover by one year ($p<0.0006$).

The initial mean soiling frequency in non-recovered patients was significantly higher than in recovered patients ($p<0.002$). Recovered patients did not differ significantly from non-recovered patients when the age, the time of onset of constipation and soiling, the frequency of bowel movements per week, the history of severe abdominal pain, the size of the rectal ampulla, or urinary symptoms of wetting during the day, bedwetting or previous urinary tract infection were compared (Table 1). The prior use of laxative treatment and pattern of use were equally distributed in both groups of constipated children. To be counted as having recovered, patients had to be off laxatives for one month, have ≤ 2 soils per month and ≥ 3 bowel movements per

Table 2 Gender differences in the history, physical examination, and outcome

	Boys n=69	Girls n=28	p Value*
Initial:			
Bowel movements/week	5 (4)	2 (3)	<0.0001
Soiling episodes/week	13 (11)	19 (21)	NS
Abdominal pain (%)	37	68	<0.007
Presence of abdominal fecal mass (%)	33	79	<0.0001
Daytime urinary incontinence (%)	26	43	NS
Nighttime urinary incontinence (%)	38	39	NS
Previous urinary tract infection (%)	7	32	<0.004
EAS-relaxation with straining (%)	47	50	NS
1 Year follow up:			
Recovered (%)	48	32	NS
Bowel movements/week	7 (4)	7 (4)	NS
Soiling episodes/week	2 (4)	0.5 (2)	<0.001
Laxative use (%)	28	46	NS

Results are expressed as mean (SD); *Fisher's exact test or Wilcoxon's non-paired rank-sum test.

Table 3 Ability to defecate balloons

Balloon volume		Constipated children		
		Controls n=16	Recovered n=42	Non-recovered n=55
30 ml:	≤ 1 min	88%	33%*	16%*
	≤ 5 min	88%	60%	33%*†
50 ml:	≤ 1 min	88%	57%*	25%*†
	≤ 5 min	88%	64%	36%*†
100 ml:	≤ 1 min	100%	67%*	33%*†
	≤ 5 min	100%	74%*	48%*†

Fisher's exact test: * $p<0.05$ from controls; † $p<0.05$ from recovered patients.

week. Frequency of soiling had decreased in 95% of patients at one year follow up. Four patients had increased and one no change in the frequency of soiling. At one year non-recovered patients had also significantly decreased soiling frequency per week 2.6 (4) ($p<0.0001$), and increased stool frequency per week 7 (4) ($p<0.01$), as compared with the initial assessment. Thirty four per cent of patients were still taking laxatives frequently and most often daily at 1 year.

Girls had initially significant less frequent bowel movements and more often abdominal pain, severe constipation, and a history of urinary tract infection than boys ($p<0.007$). At one year follow up girls had significantly less frequent soiling episodes than boys ($p<0.001$) (Table 2).

STUDIES OF BALLOON DEFECACTION

Control children were able to defecate significantly more frequent the 30 ml, 50 ml, and 100 ml water filled rectal balloons in ≤ 1 min than constipated children independent if they recovered or not. Recovered patients defecated the 50 ml and 100 ml balloons in ≤ 1 min and the 30 ml, 50 ml, and 100 ml balloons in ≤ 5 min significantly more frequent than non-recovered children ($p<0.05$). The ability to defecate balloons was not because of stronger or longer straining. Constipated children defecated the larger sized balloons more frequently than the smaller sized balloons ($p<0.03$) (Table 3).

Patients with severe constipation were significantly less likely to defecate any size balloon in ≤ 1 min and ≤ 5 min ($p<0.05$). Girls were similar to boys in their ability to defecate any size balloon in ≤ 1 min and ≤ 5 min ($p>0.02$) (Table 4).

STUDIES OF THE EXTERNAL SPHINCTER AND PELVIC FLOOR DURING THE ACT OF BEARING DOWN FOR DEFECACTION

While lying in left lateral position all healthy controls and 68% of the later recovered and 33% of the later

Table 4 Ability to defecate water filled balloons in patients with severe and mild constipation

Balloon volume		Severe constipation n=45	Mild constipation n=52	p Value*
30 ml:	≤1 min	13%	33%	0.03
	≤5 min	27%	60%	0.002
50 ml:	≤1 min	18%	58%	0.0001
	≤5 min	31%	63%	0.002
100 ml:	≤1 min	32%	62%	0.004
	≤5 min	43%	73%	0.004

*Fisher's exact test.

non-recovered patients could relax the external anal sphincter during defecation attempts (Table 5). One recovered constipated child was excluded from the analysis because he did not increase abdominal pressure when told to try to defecate. Patients who later recovered were significantly less frequent able to relax the external sphincter during bearing down for defecation than controls ($p < 0.01$), but significantly more frequent able to do so than non-recovered patients ($p < 0.001$).

When comparing patients who abnormally contracted the external sphincter during defecation attempts to those who could relax the external sphincter initially, we found that patients with abnormal contraction had more often never been toilet trained (68% v 36%, $p < 0.005$), had more frequent severe constipation (60% v 30%; $p < 0.005$) and were significantly less likely to defecate the 30 ml balloon in ≤ 5 min (28% v 61%), the 50 ml balloon in ≤ 1 min (24% v 57%) and ≤ 5 min (28% v 72%) and the 100 ml balloon in ≤ 1 min (34% v 64%) and ≤ 5 min (46% v 76%) ($p < 0.005$). Patients with severe

Table 5 Anorectal function tests

	Constipated children		
	Controls n=16	Recovered n=42	Non-recovered n=55
EAS-relaxation with straining (%)	100	68*	33*†
Balloon volume (ml air):			
Threshold of rectal sensation	14 (7)	27 (14)*	25 (14)*
Critical volume	101 (39)	161 (72)*	180 (102)*
Threshold of rectosphincteric reflex	11 (5)	18 (8)*	19 (8)*
Volume for constant relaxation	104 (49)	170 (66)*	185 (101)*
Threshold for rectal contraction	54 (28)	94 (69)*	116 (99)*

Results are expressed as mean (SD); EAS=external anal sphincter and pelvic floor; Wilcoxon's non-paired rank-sum test: * $p < 0.05$ from controls; † $p < 0.05$ from recovered patients.

Table 6 Compliance in non-recovered patients

	Non-recovered patients		p Value*
	Compliant n=31	Non-compliant n=23	
Female gender	55%	9%	<0.0005
Initial:			
Age (yr)	8.7 (2.5)	9.4 (2.4)	NS
Bowel movements/week	3 (4)	5 (5)	NS
Soiling frequency/week	18 (17)	18 (16)	NS
Abdominal pain (%)	55	30	NS
Presence of abdominal faecal mass (%)	74	48	NS
Daytime urinary incontinence (%)	35	22	NS
Nighttime urinary incontinence (%)	45	35	NS
Previous urinary tract infection (%)	32	4	<0.02
1 Year follow up:			
Bowel movements/week	7 (4)	7 (4)	NS
Soiling frequency/week	0.5 (1)	5 (5)	<0.0001

Results are expressed as mean (SD); *Fisher's exact test or Wilcoxon's non-paired rank-sum test.

constipation were less likely to recover when they abnormally contracted the external sphincter and pelvic floor during bearing down than those who could relax ($p = 0.05$).

STUDIES OF THE EFFECT OF RECTAL DISTENSION
Recovered as well as non-recovered constipated children required initially significantly larger balloon volumes to produce a rectal sensation, a rectosphincteric reflex, an urge to defecate, constant relaxation of both the external and internal anal sphincters, and a rectal contraction of ≥ 10 mmHg than control children ($p < 0.05$). These balloon volumes were not significantly different between recovered and non-recovered patients ($p > 0.3$). The 45 patients with severe constipation required significantly larger air volumes to produce an urge to defecate (critical volume 203 (101) ml), constant relaxation of both anal muscles (201 (99) ml), and a rectal contraction (126 (104) ml) than the 52 patients who had mild constipation (145 (72); 160 (72); and 89 (67) ml, respectively) ($p < 0.05$). The threshold volumes for rectal sensation and the rectosphincteric reflex were not significantly different between patients with mild and severe constipation. Girls were not different than boys in all these rectal distension tests (Table 5).

COMPLIANCE WITH TREATMENT

Twenty three of 54 non-recovered patients were rated as non-compliant. In one non-recovered

patient we could not determine compliance. As can be seen in Table 6 non-recovered girls were rated as being significantly more compliant than non-recovered boys ($p=0.0005$). Non-recovered patients who had a previous history of urinary tract infection were significantly more compliant than those without ($p<0.02$). This is due to the large proportion of non-recovered girls being compliant and girls having a more frequent history of urinary tract infection than boys ($p<0.004$). As can be seen in Table 6, none of the other initial historical or physical parameters related to compliance. Compliant non-recovered patients had significantly less frequent soiling at one year than non-compliant non-recovered patients ($p<0.0001$). Compliant and non-compliant non-recovered patients were similar in their ability to relax the external sphincter and pelvic floor during straining, their inability to defecate any size balloon in ≤ 1 min and ≤ 5 min, and in the air volumes required for the rectal distension tests.

Stepwise logistic regression revealed that female gender related significantly to compliance ($p<0.002$), while severe constipation, abnormal contraction of the external sphincter and pelvic floor, inability to defecate balloons, and the air volumes required for the rectal distension tests did not add significantly to the prediction of compliance.

FACTORS WHICH CONTRIBUTED TO TREATMENT FAILURE

Stepwise logistic regression revealed that the presence of severe constipation ($p<0.005$), abnormal contraction of the external sphincter ($p<0.01$), and inability to defecate the 100 ml balloon in ≤ 1 min ($p<0.04$) related to treatment failure. Gender and the inability to defecate the 30 ml and 50 ml balloons in ≤ 1 min and all balloons in ≤ 5 min did not add significantly to the predication of treatment failure. Volumes for threshold of rectal sensation, critical volume, and rectal contraction and compliance did not add significantly to the predication of outcome.

Discussion

In this study 57% of children with chronic constipation and overflow incontinence had not recovered by one year. Non-recovered patients were significantly more likely than recovered patients to have had severe constipation and more frequent soiling episodes, and were significantly less likely to defecate water filled rectal balloons and to relax the external anal sphincter during bearing down for defecation. Stepwise logistic regression revealed that the presence of severe constipation ($p<0.005$), abnormal contraction of the external sphincter during defecation ($p<0.01$), and inability to defecate the 100 ml

balloon in ≤ 1 min ($p<0.04$) related significantly to treatment failure.

It had been suggested that non-compliance with treatment³ and behavioural problems were responsible for soiling. Our study shows that non-compliance with treatment did not significantly add to treatment failure in the logistic regression model once the abdominal faecal mass and abnormal external sphincter contraction were accounted for. Non-compliance with treatment was significantly more common in boys than in girls ($p<0.02$). Non-compliant patients had significantly more frequent soiling episodes at one year than non-recovered compliant patients ($p<0.0001$).

There is a vast amount in the literature about behavioural problems in faecal incontinent children, but few studies have addressed the question of whether there is an association between behavioural deviance and the problem of faecal soiling. Using the Child Behavior Checklist¹⁸ we and others^{19,21} have found that faecal incontinent children as a group did have numerous behavioural problems, but the scores did not differ significantly when compared with standardised norms of children.^{19,21} The behavioural problem score in faecal incontinent children did not reach the severity that would be found in a population of children referred for mental health services. We found that persistence of faecal incontinence at six months and 12 months follow-up was not related to the social competence or behavioural scores.¹⁹ The children from this behavioural study are part of the present study population. Gabel *et al*²⁰ found that moderate rises in behavioural scores predicted good outcome while very high rises and minimal or no score rise predicted poor outcome.

Initially, girls frequently had more severe constipation, a history of abdominal pain, urinary infection, and had less frequent bowel movements per week than boys. Being more symptomatic may have led to better compliance.

Most of our previous studies^{4,5,8} have shown one year recovery rates between 53 to 55%. This agrees with a 47% recovery rate reported by Abrahamian and Lloyd-Still⁷ and 58% reported by Wald *et al*²² while studies by other investigators appear to show higher recovery rates of up to 78%. Levine and Barkow⁶ reported cure in 51% of their patients and marked improvement in another 27%, but recovery was rated on the frequency of soiling and it is not clear if some of these children were still using laxatives. In addition, no mention of the frequency of severe constipation was made, but most likely was less than in our study because only 13% of patients were girls *versus* 29% in our study. In one previous publication²³ we achieved only a 36% recovery rate with laxative treatment, but 56% of the study popula-

tion had abnormal contraction of the external anal sphincter and pelvic floor with defecation and 56% had severe constipation. It is possible that our patients were particularly severe cases, as many patients came from a referral population. One might expect that a higher number of milder cases would be seen and successfully treated in a primary care setting.

Healthy children can expel faecal material from the rectum by voluntary actions. In our study we tested the ability to voluntarily defecate by having children defecate water filled rectal balloons. A healthy child can voluntarily set forth the actions connected with defecation. In this process an increase in intra-abdominal pressure is produced by closure of the glottis, fixation of the diaphragm, and contractions of the abdominal, perineal, and hamstring muscles. Seconds after the intra-abdominal pressure has increased, relaxation of the internal and external anal sphincter occurs. In 52% of constipated children the anal canal pressure did not decrease, rather it increased because the external anal sphincter was contracted during attempted voluntary defecation, explaining the difficulties to defecate rectal balloons.

Surface EMG recordings were used in our paediatric patients because they sample a larger area of the external anal sphincter than needle EMG and do not produce pain. The external anal sphincter, and in addition other surrounding pelvic floor muscles, are contracted during these abnormal defecation attempts, and surface EMG electrodes may pick up also action potentials from these muscles. In all our recordings we simultaneously recorded pressure inside the anal canal. When the EMG activity increased the anal pressure increased.

Many children able to relax the external sphincter during bearing down for defecation were not able to defecate the rectal balloons but the ability to defecate the balloons increased significantly with increasing balloon volume. To find an increased ability to defecate the larger balloons in the constipated children who could relax the anal canal during bearing down may be explained by the following physiologic observations. Rectal distension by faeces, air or water filled balloons will inhibit the external and internal anal sphincters and induce rectal activity. We found that constipated children who could and could not relax the external anal sphincter during defecation attempts required significantly larger rectal balloon volumes to inhibit the anal sphincters and to induce rectal contractions than healthy children. It may be that the increased ability to defecate the larger balloons in the constipated children was caused by inhibition of the internal and

external sphincter muscles and induction of rectal activity by the larger balloon volumes.

The thresholds for rectal sensation and the rectosphincteric reflex were significantly increased in patients with relaxation and contraction of the external anal sphincter and pelvic floor as compared with controls. In our previous studies^{4,8} different groups of control children were studied and the means (SD) were found to be slightly higher for threshold of rectal sensation 17 (7)⁴ versus 14 (7) mmHg in the present study, and the thresholds of the rectosphincteric reflex were 17 (7),⁴ 13 (4),⁸ and 11 (5) mmHg in the present study. Therefore, the finding of a significant difference for the threshold of the rectosphincteric reflex between controls and the two groups of constipated children should be interpreted with caution.

We know from previous studies that constipated children will not learn to relax the external sphincter during milk of magnesia therapy.²³ Why then did constipation and encopresis during milk of magnesia treatment improve in patients who abnormally contracted the external sphincter during defecation attempts? Is it because rectal and/or colonic activity is induced which will drive the stool through the anal canal and/or is the habit training through frequent toilet sitting after meals most crucial in a treatment programme? With laxative treatment patients acquired more frequent bowel movements which decreased the likelihood of faecal impaction and consequent soiling.

Studies ongoing in our laboratory,²⁴ by Wald *et al*,²² and Emery *et al*¹⁵ show that the inability to relax the external sphincter and pelvic floor during defecation is the result of an unconscious altered motor behaviour and 80% of these children can learn to relax the external sphincter and pelvic floor after biofeedback treatment.²⁴

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