ORIGINAL ARTICLES

Is encopresis always the result of constipation?

M A Benninga, H A Büller, H S A Heymans, G N J Tytgat, J A J M Taminiau

Abstract

Encopresis is often the result of chronic constipation in the majority of paediatric patients. In clinical practice, however, encopresis is also seen without constipation and it is unknown whether these two clinical variants are based on similar or different pathophysiological mechanisms, requiring different therapeutic approaches. We analysed clinical symptoms, colonic transit time (CTT), oro-caecal transit time (OCTT), anorectal manometric profiles, and behavioural scores. Patients were divided into two groups, one consisted of 111 children with paediatric constipation, and another group of 50 children with encopresis and/or soiling without constipation.

Significant clinical differences in children with encopresis/soiling existed compared with children with paediatric constipation regarding: bowel movements per week, the number of daytime soiling episodes, the presence of night time soiling, the presence and number of encopresis episodes, normal stools, pain during defecation, abdominal pain, and good appetite.

Total and segmental CTT were significantly prolonged in paediatric constipation compared with encopresis/soiling, 62.4 (3.6–384) and 40.2 (10.8–104.4) hours, respectively. No significant differences were found in OCTT. Among the two groups, all manometric parameters were comparable, except for a significantly higher threshold of sensation in children with paediatric constipation. The defecation dynamics were abnormal in 59% and 46% in paediatric constipation and encopresis/soiling, respectively, and were significantly different from controls. Using the child behaviour checklist no significant differences were found when comparing children with paediatric constipation and encopresis/soiling, while both patient groups differed significantly from controls.

In conclusion, our findings support the concept of the existence of encopresis as a distinct entity in children with defecation disorders. Identification of such children is based on clinical symptoms, that is, normal defecation frequency, absence of abdominal or rectal palpable mass, in combination with normal marker studies

and normal anal manometric threshold of sensation. Thus, encopresis is not always the result of constipation and can be the only clinical presentation of a defecation disorder.

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Children with faecal incontinence are not capable of controlling their bowels. Many doctors regard it as a trivial symptom which will eventually disappear. Apart from the shame and fear of discovery, however, it may lead to social withdrawal, low self esteem, and depression.^{1–3} Despite these consequences in children, encopresis and soiling have received less attention than enuresis.

The term encopresis was originally introduced by Weissenberg in 1926 to characterise the faecal equivalent of enuresis.⁴ Many have tried to define and classify encopresis, but no agreement has been reached. Some workers divide encopresis into either faecal incontinence with evidence of constipation (psychogenic constipation, psychogenic megacolon, paradox diarrhoea, or overflow incontinence),^{5–8} so called retentive encopresis, or non-retentive encopresis. The latter is further subdivided into a primary (or continuous) form (faecal incontinence with no evidence of constipation occurring in children who have not been toilet trained successfully) and secondary (or discontinuous) non-retentive encopresis (occurring in children who were completely toilet trained and subsequently regressed to incontinence).^{9–11} In contrast, however, Levine stated that virtually all children with encopresis retain stools.¹ He suggested that a plain radiograph of the abdomen often exposed substantial faecal retention, despite a normal history and physical examination. He therefore considered the term 'encopresis without constipation' to be incorrect.

The term faecal incontinence encompasses encopresis and soiling. The important difference is the amount of faeces lost. These two terms are often used indistinguishably in published work. In this study we define encopresis as the voluntary or involuntary passage of a normal bowel movement in the underwear (or other unorthodox locations), after the age of 4 years, occurring on a regular basis without any organic cause.^{5 12 13} Thus encopresis is defined on the basis of a sign, rather than the presence or absence of

Academic Medical
Centre, Amsterdam,
The Netherlands
M A Benninga
H A Büller
H S A Heymans
J A J M Taminiau

Department of
Gastroenterology
G N J Tytgat

Correspondence to:
Dr M A Benninga,
Department of Paediatrics,
Academical Medical Centre,
Meibergdreef 9, 1105 AZ
Amsterdam, The
Netherlands.

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constipation, and reflects defecation in the underwear. Faecal soiling is defined as the involuntary seepage of faeces which is often associated with faecal impaction, and reflects staining of the underwear.^{6 7 12}

Encopresis is reported to be responsible for 3% of referrals to teaching hospitals and has been noted in 1.3% of those over 4 and in 1–2% of 7 year olds.^{5 13 14–16} The prevalence among children of 10–12 years was 1.3% for boys and 0.3% for girls.⁵

Although faecal incontinence is a common problem in paediatric practice, the pathophysiological mechanisms are largely unknown. Marker studies have shown that the total colonic transit time (CTT) in constipated children is significantly prolonged compared with healthy controls.^{17–19} Anorectal manometry in children with constipation and encopresis showed an increased threshold to perceive rectal distention and an inability to relax the external anal sphincter during defecation.^{20–23}

To find out whether faecal incontinence exists in the absence of constipation and to unravel possible different pathophysiological mechanisms, we analysed children with constipation with or without encopresis/soiling and children with encopresis/soiling only. Differences among these patients regarding their clinical symptoms, CTT, oro-caecal transit time (OCTT), anorectal manometric profiles, and scores on the child behaviour checklist (CBCL) were evaluated.

Methods

SUBJECTS

In this study, 161 otherwise healthy patients with defecation disorders, aged 5–17 years, were referred between 1991 and 1993 to our paediatric intestinal motility unit of a tertiary academic teaching hospital. Patients were referred by general practitioners, school doctors, paediatricians, or child psychiatrists. Patients had to fulfil at least two of our four criteria of paediatric constipation to participate in the study: (a) stool frequency less than three each week; (b) two or more soiling/encopresis episodes each week; (c) periodic passage of large amounts of stool at least once every seven to 30 days; and (d) a palpable abdominal or rectal mass. In addition, all patients were enrolled with two or more episodes each week of encopresis or soiling alone without any of the other criteria for paediatric constipation. A palpable rectal mass was defined as the presence of a faecal lump in the rectal ampulla. Known causes of constipation, such as Hirschsprung's disease, spina bifida occulta, hypothyroidism or other metabolic or renal abnormalities, mental retardation, and children receiving drugs other than laxatives were excluded.

Each child underwent a complete work up that encompassed a detailed medical history and a thorough physical and digital rectal examination. Specific attention was paid to defecation frequency on the toilet, questions about the amount of stools lost in the

underwear (encopresis, soiling), and time of occurrence. In addition, transit time studies and anorectal manometry were performed and the CBCL was completed. The study was approved by the hospital's medical ethics committee. Written informed consent was obtained from patients or their parents, or both.

Healthy controls for the OCTT test and for the anorectal manometry were 39 and 15 healthy children, respectively. Informed consent was obtained from the subjects and their parents.

ASSESSMENT OF OCTT AND CTT

Because of poor compliance in children regarding the intake of alimentary fibre, no standardisation was attempted and measurement of OCTT and CTT were performed in patients taking their own customary diet. Treatment with laxatives (pills or enemas) was always interrupted at least four days before the study. No subject had received antibiotics for at least three months before the test.²⁴

COLONIC TRANSIT TIME

Total and segmental analysis of CCTs were carried out as reported previously.²⁵ Patients ingested a capsule with 20 radio-opaque markers on three consecutive days at 9.00 am. Abdominal radiographs were obtained on the same time in the morning on day 1 and four days after ingestion of the last capsule. Additional abdominal radiographs were taken seven, 10, and 13 days after ingestion of the last capsule if more than 20% of markers were still present. Abdominal radiographs were obtained using a high kilovoltage fast film technique to reduce radiation exposure (estimated surface exposure 0.08 mrad per film).

Localisation of markers on abdominal films relied on the identification of bony landmarks as described by Arhan *et al.*²⁶ Markers were counted in the right, left, and rectosigmoid regions, and mean segmental transit times were calculated as described.^{25 26} The normal range for segmental transit times were taken from the limits (mean (2 SD)) from a study of Arhan *et al* in healthy children.²⁶

OROCAECAL TRANSIT TIME

The method used to study OCTT was as described by van der Kley-van Moorsel *et al.*²⁷ Studies were performed after an overnight fast. End expiratory breath samples were taken before the ingestion of 10 g lactulose (20 ml of 50% solution) and at 15 minute intervals thereafter up to a maximum of 240 minutes.²⁸ At all time points, measurements consisted of two samples taken one minute apart. The breath was collected in a 60 ml plastic syringe with a side hole and a mouthpiece at the tip opening.²⁷ The hydrogen content of the expelled air was measured by the Hoekloos Lactoscreen²⁷ and expressed in parts per million (ppm). The OCTT was defined as the

Table 1 Clinical features of groups defined by symptoms. The entries are number (%) or median (range)

	Paediatric constipation (n=111)	Encopresis/soiling (n=50)	p Value
Boys	75 (68)	43 (86)	0.02
Age	8.0 (5–14)	9.0 (5–17)	0.01
Age of onset of symptoms (months)			
<12	28 (25)		
12–48	52 (47)		
Toilet trained	61 (56)	34 (69)	0.12
Age at which toilet training started (years)	1.5 (0.8–4)	2.0 (1–4)	0.02
Primary encopresis	27 (25)	23 (47)	0.02
Family history of constipation	42 (38)	15 (30)	0.38
Bowel movements/week	2.0 (0–10)	7.0 (3–17)	<0.01
Large amount of stools (7–30 days)	68 (61)	0 (0)	<0.01
Daytime soiling	86 (77)	34 (68)	0.33
Episodes/week	7.0 (0–56)	3.5 (0–28)	0.03
Night time soiling	33 (30)	6 (12)	0.02
Episodes/week	0 (0–7)	0 (0–10)	0.02
Encopresis	36 (32)	33 (66)	<0.01
Episodes/week	0 (0–35)	3.0 (0–28)	<0.01
Normal stools (consistency)	60 (54)	41 (82)	0.03
Pain during defecation	55 (50)	15 (30)	0.03
No rectal sensation	20 (18)	3 (6)	0.05
Abdominal pain	46 (41)	11 (22)	0.02
Good appetite	64 (58)	39 (78)	0.01
Daytime urinary incontinence	12 (11)	7 (14)	0.37
Night time urinary incontinence	29 (26)	10 (20)	0.43
Palpable abdominal mass	39 (35)	0 (0)	<0.01
Palpable rectal mass	31 (28)	0 (0)	<0.01

period between lactulose intake by mouth and an increase in hydrogen excretion of 10 ppm above basal values. The test was terminated when this increase in hydrogen excretion sustained two subsequent time intervals. Non-hydrogen producers were defined as children with a peak excess breath hydrogen concentration <10 ppm after lactulose ingestion.

ANORECTAL MANOMETRY

A five lumen manometric anal probe of 4.8 mm outer and 0.8 mm inner diameter was used as described earlier.²⁹ Two side holes at a spacing of 3 cm were perfused with sterile water at a rate of 0.5 ml/min by a hydraulic infusion system (Arndorfer).³⁰ A rectal distending balloon with a high compliance was tied to the tip of the probe, 3 cm above the first side hole. Pressures were measured by transducers in each perfusion line and connected to PC Polygraf HR preamplifiers (Synectics Medical). The analogue signals from the preamplifier were digitally converted and transmitted via a fibre optic cable to a personal computer.

Maximum anal resting tone and maximum squeeze pressure were measured by stationary pull through at a rate of 1 cm/min. Sensory threshold was defined by the smallest reproducible volume of rectal distension sensed. Critical volume, the minimum amount of air required to produce the sensation of a persistent urge to defecate (for at least one minute), was determined by filling the rectal balloon stepwise in increments of 30 ml at intervals of 30 seconds. Intra-abdominal pressure was defined as the increase of pressure above the steady state level during a defecation attempt. The defecation dynamics, the manometric profile obtained by expelling the rectal balloon, was assessed during at least five simulated defecation trials. The rectoanal inhibitory reflex was measured in response to balloon distension to exclude (short segment) Hirschsprung's disease. No sedation was used.

ELECTROMYOGRAPHY

Electrical activity of the external anal sphincter was recorded by one reference and two differential electrodes connected to a bioamplifier II and the PC Polygraf HR. Electrocardiogram pregelled disposable neonatal electrodes overlaying the subcutaneous part of the external anal sphincter were used. The reference electrode was located on a thigh. Defecation dynamics were defined as normal if the integrated electromyogram of the external anal sphincter showed a decrease or no change during expulsion of the balloon in at least two of five defecation attempts. Defecation dynamics were defined as abnormal if a manometric and myoelectrical increase occurred during bearing down in at least four of the five defecation attempts.^{22 31 32}

CHILD BEHAVIOUR CHECKLIST

The CBCL is a questionnaire developed by Achenbach and is designed to report in a standardised way the behaviour of children aged 4 to 16 years as assessed by their parents or parent proxy.³³ The CBCL was completed within 14 days after the initial visit. Normalised T scores for the social competence scale, the internalisation score, the externalisation score, and the total behavioural score are standardised for age and gender.³⁴ The behavioural ratings were compared with the behavioural ratings of the CBCL normative sample of non-referred Dutch children (n=2076), all of whom are profiled by age and gender.³⁴

STATISTICAL METHODS

Data were collected using an integrated patient database. Results will be expressed using the median and the range for continuous variables and percentages for discrete variables. Groups were compared using the Wilcoxon paired signed rank test for continuous variables and the χ^2 test for discrete variables, calculating exact p values for the latter. For all tests a level of 0.05 was used for significance.

Results

PATIENTS

This study encompasses 161 patients evaluated for constipation or encopresis/soiling, or both. Based on our definition of paediatric constipation, patients were divided into two groups. The first group consisted of 111 patients who fulfilled the criteria for paediatric constipation as described earlier. The second group consisted of 50 patients with encopresis or soiling alone, or both, without other criteria of paediatric constipation.

In 39 healthy children (5–14 years, average 9.9 years; 18 boys and 21 girls) breath hydrogen samples were taken to obtain normal OCTTs. Controls for the manometric values consisted of 15 healthy children (7–15 years, average 11 years; 10 boys and five girls).

Apart from a significant preponderance of boys in the encopresis/soiling group, children

Table 2 CTT in hours (mean and range)

	Paediatric constipation (n=111)	Encopresis/soiling (n=50)	Arhan* (n=23)
Right colon	13.8 (0-60) (p<0.01)	8.1 (0-26.4)	7.7 (18)
Left colon	16.1 (0-110.4) (p<0.01)	7.0 (0-19.2)	8.7 (20)
Rectosigmoid	51.0 (0-226.8) (p<0.01)	26.7 (4.8-93.6)	12.4 (34)
Total colon	81.0 (3.6-380.4) (p<0.01)	41.7 (10.8-104.4)	29.0 (62)

*The last column represents the mean values; the values in brackets are upper limits of normal range (mean (2 SD)) measured by Arhan *et al.*²⁶

with encopresis/soiling were significantly older than the patients with paediatric constipation (table 1). The age at which parents first remembered a bowel problem in the paediatric constipation group was, in most children, between 12 and 48 months. In the 27 children with secondary encopresis, bowel problems started at a median age of 6 years (2-10 years). The remaining 23 children of the encopresis/soiling group were never continent for faeces (primary encopresis). The median duration of constipation was 60 months in the paediatric constipation group (2-171 months). In the encopresis/soiling group the median period of the disorder was 10 years (5-14) and 50 months (3-137) for primary and secondary encopresis/soiling respectively.

ONSET OF CONSTIPATION

As mentioned by the parents, no definable events were present at the onset of constipation in most paediatric constipation and encopresis/soiling children (68% and 78% respectively). Definable events such as diet changes (human to cows' milk), anal fissures, failed toileting, birth of a sibling, family problems, moving to a new home, changing school, intercurrent illness, or sexual abuse were present at onset in a minority of cases (maximum 8%).

BOWEL FUNCTION

As shown in table 1, the median number of bowel movements in the paediatric constipation group was two times each week, whereas the encopresis/soiling patients defecated on the toilet daily. As reported by the encopresis/soiling patients or their parents, or both, the stools were of normal size, without a periodic passage of a large amount of stools.

The number of day or night time, or both, soiling episodes was significantly higher in the paediatric constipation group compared with the encopresis/soiling group. The presence and number of episodes of encopresis was

significantly more common in the encopresis/soiling group. In the paediatric constipation group 13% of the children, six boys (8%) and seven girls (19%), did not have faecal incontinence.

ASSOCIATED SYMPTOMS

A large number of children with paediatric constipation experienced abdominal pain, although this was only found in a minority of encopresis/soiling children. A significantly higher proportion of encopresis/soiling patients had a good appetite compared with the paediatric constipation patients. There was no significant difference in frequency between the two groups regarding day or night, or both, urinary incontinence. The existence of urinary tract infection was not evaluated in this study.

ANORECTAL SYMPTOMS AND PHYSICAL EXAMINATION

By definition no faecal masses were palpable in the encopresis/soiling group. In the paediatric constipation groups, however, approximately a third revealed palpable abnormalities. On rectal examination the tone of the internal anal sphincter and voluntary contraction of the external anal sphincter was normal in the two groups. Anal fissures (only one in the paediatric constipation group) and haemorrhoids in the paediatric constipation (three) and encopresis/soiling (two) groups were rarely seen.

TREATMENT

In the paediatric constipation and encopresis/soiling group 59 and 28% of the patients respectively used laxative for long periods of time without success. The duration of the laxative treatment, including lactulose, mineral oil, and stimulant laxatives given by mouth or by enema, was 49 months (3-135 months) in children with constipation and 46 months (6-93 months) in the other group. In the paediatric constipation and encopresis/soiling group additional psychiatric treatment was given to 26% and 18% respectively. In the encopresis/soiling group most (62%) had never received any earlier treatment. In children with paediatric constipation this was only 39%. These non-treated children initially visited a doctor at a significantly older age, median 9 years (6-15 years) in the encopresis/soiling group, compared with 8 years (5-14 years) in the paediatric constipation group. Separation within the paediatric constipation and encopresis/soiling group into those receiving laxative treatment and those who were not treated before did not show any significant difference in the clinical features, except for a significantly higher frequency in large amount of stools (7-30 days) in the untreated paediatric constipation patients.

COLONIC TRANSIT TIME

Table 2 shows the different segmental and total CTT values. Total CTT was significantly

Table 3 Results of anorectal manometry (median and range)

	Paediatric constipation (n=111)	Encopresis/soiling (n=50)	Healthy controls (n=15)
Maximum anal resting tone (mm Hg)	56.0 (27-93)	63.5 (18-95)*	46.0 (33-90)
Maximum squeeze pressure (mm Hg)	138.0 (65-288)	140.5 (62-264)	167.0 (81-276)
Abdominal resting pressure (mm Hg)	10.0 (1-35)	8.5 (1-34)	10.0 (4-18)
Intra-abdominal pressure (mm Hg)	67.0 (16-151)	64.0 (0-180)	65.0 (32-131)
Threshold of sensation (ml)	25.0 (5-360)*†	15.0 (10-90)	20.0 (5-50)
Threshold of reflex (ml)	27.5 (5-60)*	25.0 (10-60)*	17.5 (5-40)
Critical volume (ml)	150.0 (60-360)	120.0 (60-330)	120.0 (60-180)
Defecation dynamics (normal)	41%*	54%*	93%

*Statistically significant from controls. †Statistically significant from encopresis/soiling group.

higher in the paediatric constipation group compared with the encopresis/soiling group.

In 56 of 111 paediatric constipation patients the total CTT was within the normal limits.²⁶ In 22 patients with paediatric constipation with total CTT >62 hours a significant delay in transit occurred in the rectosigmoid only, whereas significantly increased transit times in all segments were observed in 14 paediatric constipation patients. In the encopresis/soiling group 44 patients had a total CTT within the normal range. In five encopresis/soiling patients with a total CTT >62 hours, the accumulation of markers occurred in the rectosigmoid.

OROCAECAL TRANSIT TIME

The OCTT (median and range) in paediatric constipation, encopresis/soiling, and controls was 60 (30–180), 60 (30–105), and 60 (30–120) minutes respectively. In the paediatric constipation group eight children (7%) were classified as non-hydrogen producers, whereas in the encopresis/soiling group only two children (4%) had breath hydrogen peaks <10 ppm above baseline values throughout the three hour test period. All healthy controls were hydrogen producers with breath hydrogen peaks of >10 ppm above baseline values.

ANORECTAL MANOMETRY

In 31 paediatric constipation children with extreme faecal retention, disimpaction with enemas was performed daily during the week before manometry to guarantee an empty rectal ampulla and to standardise the anorectal measurements for all patients. No enemas were given on the day of manometric measurements. The remaining patients required no enemas before manometry. Table 3 shows that all manometric parameters were comparable between the two patient groups, apart from a significantly higher threshold of sensation ($p=0.008$) in children with paediatric constipation. Maximum anal resting tone was significantly higher in the encopresis/soiling group ($p=0.04$) than controls. Only the paediatric constipation group required significantly larger balloon volumes to provoke a rectal sensation ($p=0.02$) compared with healthy controls. In encopresis/soiling patients this threshold was even lower than in controls. Significant higher balloon volumes were needed in the two patient groups compared with control children ($p=0.02$ and $p=0.02$ respectively) in eliciting the rectoanal inhibitory response. The defecation dynamics were abnormal in 59% and 46% in the paediatric constipation and encopresis/soiling groups respectively and were significantly different from controls ($p<0.001$). All children exhibited a rectoanal inhibitory reflex on balloon distension.

SUBDIVISION OF PATIENTS

Subdivision of the constipated group of children (paediatric constipation) into those

with and without faecal incontinence and subsequent comparison with the encopresis/soiling group yielded no differences in the above mentioned clinical features, transit times, and manometric results, as presented in tables 1–3. Similarly, no significant difference was found between those children with paediatric constipation with faecal incontinence and those without faecal incontinence. These findings allow the separation into only two groups.

CHILD BEHAVIOUR CHECKLIST

On the CBCL, children with paediatric constipation and encopresis/soiling showed high percentages (38.5% and 44.2% respectively) in the clinical range of behavioural problems, but no significant difference was found between the two groups. In the two groups these scores for behavioural problems differed significantly ($p<0.01$) compared with the 10% abnormal clinical range found in control children.

Discussion

It is generally believed that encopresis is secondary to constipation; Levine, in particular, suggested this association.¹ A pilot study, however, implied the existence of a group of children with encopresis without evidence of constipation.²⁹ In this study we show that such children form a distinct group among patients with defecation disorders, with discrete clinical and manometric features and normal CTT. In these children solitary encopresis is the most important clinical sign.

Most parents of these children, especially in those with primary encopresis, postponed an initial visit to a doctor for many years, despite the humiliation. Many parents were unaware of the existence of encopresis as a common childhood problem and ascribed it to laziness, inattention, poor hygiene, or stress; shame and cultural taboos were other common reasons for this delay. In contrast, infrequent defecation appeared to be a more threatening and more recognisable disorder and therefore parents of children with paediatric constipation consulted a doctor earlier.

Levine has provided an age dependent list of potential risk factors for encopresis, based on constitutional predispositions, circumstances, of environment, and critical life events.¹ Nevertheless, only in a minority of patients in this study could these factors be identified. In most children the cause of constipation or encopresis, or both, was unknown. More importantly, and in contrast with general opinion, encopresis or soiling alone was not often associated with too coercive and too early bowel training as these children were less and later toilet trained than the paediatric constipation group. It is possible that changed cultural opinions and behaviour about bowel training explains the differences between our findings and the previous studies.

In children with constipation, the retention of stools often leads to a vicious circle

in which the rectum is increasingly distended by abnormally firm faecal contents.¹ The infrequent passage of these hard and large amounts of stools induces pain during defecation, inhibition of voluntary efforts, and results in abnormal sphincter contraction during defecation. Finally, chronic rectal distension causes soiling, sometimes encopresis, loss of rectal sensitivity, and hence a normal urge to defecate.^{20 35 36} Levine stated that in most children with faecal incontinence a plain radiograph of the abdomen would unmask extensive faecal retention.¹ This study shows that a third of the children referred for faecal incontinence showed no signs of constipation. Almost all encopresis/soiling children defecated daily, resulting in significantly fewer constipation associated complaints – for example, abdominal pain and poor appetite. Importantly, and in contrast with children with paediatric constipation, encopresis/soiling patients exhibited no abnormalities on abdominal and rectal examination. Furthermore, no aberrations were found on radiographic examination in most encopresis/soiling patients using Barr scores, suggesting that children with encopresis/soiling form a distinct group of patients.³⁷

The existence of night time soiling, the loss of loose stools in pyjamas, was significantly higher in the paediatric constipation group than in children with encopresis/soiling. In nearly all instances this was correlated with severe faecal impaction and extreme prolonged total CTT (>100 hours).³⁸ In encopresis/soiling children this correlation was not observed.

Preliminary treatment analysis showed that children with paediatric constipation were often helped by laxative treatment, whereas, in contrast, children with encopresis/soiling were seldom helped, and even became worse. Review of published work showed that various approaches have been recommended for the management of children with encopresis. Among these have been individual and family psychotherapy, behaviour modification programs and bowel retaining regimens.^{39–42} Most published studies were either single case reports or consist of small groups of children with encopresis/soiling.⁴³ Nolan *et al* showed in children with encopresis and evidence of accumulated stool on plain abdominal radiograph, an obvious additional advantage of laxative drugs and behaviour modification to behavioural modification alone.⁴⁴ Previously, we showed in a non-randomised study that children with encopresis and soiling alone were significantly improved after biofeedback training.²⁹

The use of radio-opaque markers is important to objectify reports of constipation and or faecal incontinence, which does not depend on possible inaccurate recall.^{45–47} Using the Metcalf method an important difference was found between the two groups.²⁵ Total as well as segmental CTT was significantly prolonged in children with paediatric constipation compared with those with encopresis/soiling. This confirms that children with encopresis/soiling

have normal bowel movements daily. It is unclear whether children with rapid colonic transit and solitary encopresis without other symptoms of constipation may be helped by suppression of intestinal motility rather than laxative treatment. Interestingly, colonic inertia, slowing of markers through all colonic segments, was only found in paediatric constipation children.^{48 49}

No significant differences were found in OCTT in all children studied, suggesting no aetiological role of the small bowel in constipation or encopresis, or both, as described previously.⁵⁰

Studies of anal sphincter pressures in constipated children with or without faecal incontinence have been contradictory; maximum anal resting tone has found to be increased, decreased, or not different from controls.^{21 22 51–53} The hypertonicity of the anal canal, as found in the encopresis/soiling group only, is unexplained. Arhan *et al* suggested that hypertonicity of the anal canal could lead to outlet obstruction.¹⁷ In the encopresis/soiling group, however, no such correlation could be found when rectosigmoid transit time and maximum anal resting tone were analysed. Similarly, no such correlation could be found in patients with paediatric constipation, despite a significant slowing of markers in the rectosigmoid in this group. Therefore it seems unlikely that anal resting tone is an important factor in the pathophysiology of outlet obstruction in children with constipation or faecal incontinence, or both.

The threshold of sensation in children with paediatric constipation was significantly higher than in controls and, as stated before, most likely the result of faecal impaction.^{19–21 54} Surprisingly, the balloon volume needed to provoke rectal sensation in children with encopresis/soiling was even lower than in controls, suggesting that patients with encopresis/soiling are able to perceive normal rectoanal stimuli. Furthermore, none of these children had faecal impaction on rectal examination and most showed normal total CTT on marker studies. In most of those with encopresis/soiling ‘accidents’ happened after 3.00 pm, whereas in paediatric constipation children lost faeces any time during the day. Children with encopresis/soiling commonly trace the failure to ‘no time to go to the toilet’ or, ‘I could not leave my computer game’, or ‘I did sense the urge, but I was just too late’, suggesting that these children deny or neglect their normal and appropriate physiological stimuli. Interestingly, many children with encopresis/soiling initially stated an absence of any sense or urge to defecate.

In the two groups a high percentage of children showed a paradoxal anal response to straining – that is, contraction rather than relaxation of the anal sphincters on defecation attempts. This phenomenon was earlier reported to occur in up to 55% of children and adults with defecation disorders.^{22 23 55} The cause of this pelvic floor dyssynergia is unknown. In children with paediatric constipation it is suggested that the pain related to

the defecation of large, firm stools may result in unconscious contraction of sphincters to avert or stop pain during defecation.^{22 56} Encopresis/soiling patients had, however, except for two children, no history of constipation and none reported the periodic passage of large amounts of stools. They had significantly less pain during defecation and significantly more normal stools than children with paediatric constipation, suggesting that anal pain is not the only reason for abnormal expulsion patterns. In addition, within the encopresis/soiling group, rectosigmoid transit time did not differ among the children with normal or abnormal defecation dynamics, whereas in children with paediatric constipation, abnormal defecation dynamics were significantly associated with slowing of markers in the rectosigmoid ($p=0.03$) compared with those children with paediatric constipation who had normal dynamics (data not shown). Loening Baucke showed a decrease in rectosigmoid motility in chronically constipated children.⁵⁷ Thus, in patients with paediatric constipation abnormal defecation dynamics are related to the slowing of rectosigmoid transit time and decreased rectosigmoid motility. In contrast, abnormal defecation dynamics in children with encopresis/soiling did not result in prolonged rectosigmoid or total CTT, nor did it lead to abnormal defecation frequencies. This suggests that these children, despite a pathological defecation technique, are able to produce complete or nearly complete bowels. As mentioned above, children with encopresis/soiling often begrudge the time necessary to visit the toilet and consequently lose some of their bowel contents during play. We suggest that after they sense the urge to defecate they let go their first stools and subsequently contract their voluntary sphincter muscles firmly. By doing this daily, they unconsciously develop abnormal defecation dynamics.

On the CBCL we observed that children with paediatric constipation and encopresis/soiling had a significantly higher incidence of behaviour problems than a normative sample of non-referred Dutch children. Loening Baucke *et al*⁵⁸ and Wald *et al*²² showed similar high percentages for behaviour problems in children with constipation and encopresis in 50% and 45% respectively. Currently a prospective study is being conducted, using the CBCL before and after treatment, to analyse whether constipation or encopresis, or both, leads to behavioural problems or vice versa.

This study illustrates the importance of the interpretation of clinical symptoms, the use of marker studies, and the value of anorectal manometry in children with defecation disorders. Not all children will present with infrequent painful defecation associated with abdominal pain and poor appetite. This study indicates that children reporting encopresis with normal defecation frequencies, without associated symptoms of constipation, with normal CTTs and normal threshold of anal sensation probably form a distinct entity

among children with defecation disorders. In our, as yet, limited experience these children respond favourably to behavioural treatments such as biofeedback training.

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