



ELSEVIER

^aDepartment of Pediatric Gastroenterology, Emma Children's Hospital/Academic Medical Center, Amsterdam, the Netherlands

^bDepartment of Child and Adolescent Psychiatry, Saarland University Hospital, Homburg, Germany

^cPaediatric Gastroenterology Victoria, Royal Children's Hospital, Melbourne, Australia

^dDivision of Pediatric Urology, University of Iowa, Iowa City, United States of America

^eDepartment of Pediatrics, Aarhus University Hospital, Aarhus, Denmark

^fDepartment of Urology, Boston Children's Hospital, Boston, United States of America

^gChildren's Urology Group, All Children's Hospital/Johns Hopkins Medicine, University of South Florida, Tampa, FL, United States of America

^hTaipei Tzu Chi Hospital, Buddhist Medical Foundation, New Taipei, Taiwan

ⁱSchool of Medicine, Buddhist Tzu Chi University, Hualien, Taiwan

Correspondence to:
I.J.N. Koppen, Emma Children's Hospital/Academic Medical Center, Department of Pediatric Gastroenterology, Room C2-312, Meibergdreef 9, 1105 AZ Amsterdam, the Netherlands, Tel.: +31205665270; fax: +31205669478

i.j.koppen@amc.nl
(I.J.N. Koppen)

Keywords

Fecal incontinence; Nonretentive; Soiling; Encopresis

Received 30 June 2015
Accepted 30 September 2015
Available online 21 October 2015

Educational article

Management of functional nonretentive fecal incontinence in children: Recommendations from the International Children's Continence Society



I.J.N. Koppen ^a, A. von Gontard ^b, J. Chase ^c, C.S. Cooper ^d, C.S. Rittig ^e, S.B. Bauer ^f, Y. Homsy ^g, S.S. Yang ^{h,i}, M.A. Benninga ^a

Summary

Background

Fecal incontinence (FI) in children is frequently encountered in pediatric practice, and often occurs in combination with urinary incontinence. In most cases, FI is constipation-associated, but in 20% of children presenting with FI, no constipation or other underlying cause can be found – these children suffer from functional nonretentive fecal incontinence (FNRFI).

Objective

To summarize the evidence-based recommendations of the International Children's Continence Society for the evaluation and management of children with FNRFI.

Introduction

Fecal incontinence (FI) is defined as the loss of stools in places inappropriate to the social context at least once per month in children with a developmental age of ≥ 4 years [1]. Fecal incontinence reflects a difficult and distressing problem for children and their parents. It can lead to feelings of guilt and embarrassment, and can cause children to be either the victim of bullying [2,3], or actively involved in bullying [4]. Fecal incontinence significantly impacts quality of life [3], and may lead to issues with social functioning and lower self-esteem [5].

In approximately 95% of children with FI, no organic cause can be identified, and it is regarded as a functional defecation disorder [1,6]. In 80% of children with functional FI, this symptom is associated with functional constipation (FC) with fecal impaction causing overflow incontinence; this is characterized by the involuntary loss of soft stools that pass an obstructing fecal mass [7,8]. In the remaining

Recommendations

Functional nonretentive fecal incontinence is a clinical diagnosis based on medical history and physical examination. Except for determining colonic transit time, additional investigations are seldom indicated in the workup of FNRFI. Treatment should consist of education, a nonaccusatory approach, and a toileting program encompassing a daily bowel diary and a reward system. Special attention should be paid to psychosocial or behavioral problems, since these frequently occur in affected children. Functional nonretentive fecal incontinence is often difficult to treat, requiring prolonged therapies with incremental improvement on treatment and frequent relapses.

20% of children with functional FI, there are no signs of fecal retention; this is classified as functional nonretentive fecal incontinence (FNRFI) [1,8]. This report summarizes the current recommendations of the International Children's Continence Society for the evaluation and management of children with FNRFI.

Definition

For many years, a comprehensive definition of the disorder that is now classified as FNRFI has been lacking and FI has been described in many different ways. First, the term *encopresis* was used to describe the loss of a normal quantity of feces [9]. Later the term *soiling* was introduced, referring to passage of small amounts of stool, which stain the underwear [9,10]. This was seen as a characteristic sign of fecal overflow incontinence. However, these terms have been used interchangeably in medical literature.

Currently, the Rome III criteria are used to define functional gastrointestinal disorders. These criteria have adopted the more neutral term *fecal incontinence* rather than the terms *encopresis* and *soiling* (Table 1) [1]. Throughout this report, the terms relating to FI, FNRFI and FC are consistently used in accordance with the definitions provided by the Rome pediatric committee (Table 1).

Epidemiology

Studies on the prevalence of FNRFI in children are scarce, and many studies investigating functional FI do not differentiate between FNRFI and constipation-associated FI. To date, only an epidemiological survey performed in Sri Lanka has assessed the true prevalence of FNRFI in the pediatric population. They reported that 2.0% of children (10–16 years) experienced FI, of whom 18% were considered to have FNRFI [11]. The prevalence of FNRFI is higher among younger children [7,12], and it is significantly more common among boys, with a male to female ratio ranging from 3:1 to 6:1 [10–13].

Pathophysiology

The exact pathophysiology of FNRFI is unknown, its etiology is considered to be multifactorial. The presence of FI in general is associated with younger age, a positive family history, non-Caucasian race, male gender, important life events such as the birth of a younger sibling, parental discord, a change in living conditions, and other psychological factors [14–19].

Urinary incontinence (UI) is commonly found in children with FNRFI [20–22]. Prevalence rates of daytime and nighttime UI in FNRFI patients range between 14–50% and 20–47%, respectively [8,20,23]. Vice versa, 11% of children with dysfunctional voiding, urge incontinence or bladder overactivity fulfill the Rome III criteria for FNRFI [21]. It is hypothesized that the concurrence of both UI and FI in otherwise healthy children without signs of fecal retention might indicate one combined disorder, termed bladder and bowel dysfunction (BBD) [24,25]. Treatment of UI can have

a positive effect on FNRFI symptoms, and adequate treatment of FNRFI often induces a reduction in number of UI episodes [23,24]. These results endorse the theory of a combined, possibly neurodevelopmental or behavioral, disorder underlying BBD.

Evaluation

In children presenting with FI without an underlying organic cause, the most important objective is to differentiate between constipation-associated FI and FNRFI. Functional nonretentive fecal incontinence and FC are both clinical diagnoses, mainly based on medical history and physical examination (Table 1).

Medical history

The medical history focuses on bowel habits [1], including the frequency of FI (usually defined as number of episodes per week), age of onset, and time/situation of occurrence. In children with FNRFI, loss of stools frequently occurs in the afternoon (after school) and evening, and often during an activity [12,26]. Keeping a stool diary (e.g. for 14 days) can help to obtain reliable information on defecation patterns [27].

Moreover, attention should be paid to urinary tract symptoms, UI, drinking and voiding habits, dietary history (including loss of appetite), abdominal pain, obesity and other comorbidities, family history, use of medication, and growth and development. Information on family composition, psychosocial problems and behavioral problems needs to be elicited. Furthermore, it is important to inquire about important life events (e.g. parental divorce, family loss, and birth of siblings) and physical and/or sexual abuse. Also, all previous treatments and their effects should be listed.

Physical examination

All children presenting with FI need a thorough physical examination, including an abdominal, anorectal, and

Table 1 Rome III criteria for functional defecation disorders in children with a developmental age of at least 4 years [1]. This table summarizes the differences between functional nonretentive fecal incontinence (FNRFI), characterized by fecal incontinence without signs of fecal retention, and functional constipation, a disorder that is often accompanied by fecal incontinence as a consequence of fecal impaction leading to overflow fecal incontinence.

Functional nonretentive fecal incontinence	Functional constipation
Must fulfill all of the following for ≥ 2 months prior to diagnosis:	Must fulfill ≥ 2 criteria at least once per week for ≥ 2 months prior to diagnosis, with insufficient criteria for the diagnosis of irritable bowel syndrome:
<ol style="list-style-type: none"> 1. Defecation into places inappropriate to the social context at least once per month 2. No evidence of an inflammatory, anatomic, metabolic, or neoplastic process that explains the subject's symptoms 3. No evidence of fecal retention 	<ol style="list-style-type: none"> 1. < 3 defecations in the toilet per week 2. ≥ 1 episode of fecal incontinence per week 3. History of retentive posturing or excessive volitional stool retention 4. History of painful or hard bowel movements 5. Presence of a large fecal mass in the rectum 6. History of large-diameter stools, which may obstruct the toilet

neurological assessment. Abdominal examination mainly focuses on detection of a palpable fecal mass. During perianal inspection, physicians should determine the presence of any anatomic abnormalities, perianal feces, fissures, hemorrhoids, scars, and erythema. Hemorrhoids and fissures may indicate hard and/or large-diameter stools. Digital rectal examination provides valuable information on the presence of a rectal fecal mass, anorectal sensation, and sphincter tone, and is essential to exclude FC as a possible cause of FI. Inspection of the lower spine provides information on the height and deviation from the midline of the gluteal crease and cutaneous manifestations of an occult spinal dysraphism (hypertrichosis, dermal vascular malformation, sinus tract or subcutaneous lipoma).

Both urinary and fecal incontinence can be an indicator of sexual abuse in children [28–33]. During examination, clinicians should note the child's reaction to rectal examination. Since physical examination in most pediatric sexual abuse victims is normal, special attention should be paid to any abnormal behavior during physical examination (e.g. sexual acting out or fear) [33].

Investigations

Except for determining colonic transit time, additional investigations are not considered useful in the routine workup of FI.

Colonic transit time

Determining the colonic transit time (CTT) can be a valuable tool in the workup of a child suspected of FNRFI. Colonic transit time can be determined by a marker test, by acquiring an abdominal X-ray after ingestion of radio-opaque markers, or by colonic transit scintigraphy, a technique that visualizes the progression of a radiolabeled marker after intraluminal administration. With these techniques, both total and segmental colonic transit time can be determined. In approximately 50% of constipated children, CTT is delayed; the majority of the delay occurs in the rectosigmoid segment [26,34]. In contrast to constipated children, 90% of children with FNRFI have a normal CTT [8]. Thus, a normal defecation frequency and absence of fecal impaction during physical examination in children with FI, in combination with a normal CTT, indicates FNRFI [8]. Therefore, in inconclusive cases, CTT can help to differentiate between FC and FNRFI.

Transabdominal ultrasonography

Transabdominal ultrasonography (TUS) can be used to measure the transverse rectal diameter [35,36]. This is best accomplished with the bladder $\geq 50\%$ distended of normal capacity. An increased rectal diameter (>30 mm) is suggestive for fecal impaction, which may cause fecal overflow incontinence [37–41]. Transabdominal ultrasonography is a promising technique that may be an alternative for digital rectal examination in the future [37,39]. However, currently, there is insufficient evidence that the transverse diameter can be used as a reliable predictor of constipation and fecal impaction [42,43]. In addition, TUS can supply other useful information regarding the lower urinary tract,

such as postvoid residual volumes, bladder wall thickness, and structural abnormalities.

Abdominal X-ray

A plain abdominal radiograph is not an appropriate investigation to differentiate between FNRFI and overflow incontinence due to fecal impaction, and may result in unnecessary radiation exposure. Determining the amount of fecal load in the colon has proven to be unreliable. Different scoring systems used to evaluate these abdominal X-rays are shown to have unsatisfactory sensitivity and specificity, as well as low inter- and intra-observer reliability [42,44].

Magnetic resonance imaging

A prospective study among children with both FC and FNRFI revealed that lumbosacral abnormalities are rarely present in FNRFI patients, and that lumbosacral abnormalities do not correlate with treatment success [45]. Therefore, magnetic resonance imaging (MRI) of the spinal cord should only be performed when there is a clear indication (e.g. abnormal lower extremity findings, midline lower back skin manifestations during neurologic examination or a suspected neurologic disorder).

Rectal barostat

Rectal barostat (a rectally inserted pressure-controlled inflatable balloon) can be used to determine rectal compliance and pressure thresholds for rectal sensitivity [46]. Children with FC have higher rectal compliance than children with FNRFI and healthy controls, causing them to require a larger volume of rectal contents to reach the intrarectal pressure that provokes an urge to defecate [47]. Rectal compliance remains increased even after FC patients are in remission [48]. Currently, there are no studies showing that rectal barostat provides prognostic information or should influence management in children with FI; rectal barostat should therefore not be used in the diagnostic workup of FI.

Anorectal manometry

Anorectal manometry provides information about anorectal neuromuscular functions; it is especially useful to assess the rectoanal inhibitory reflex (RAIR), anal sphincter tone and rectal sensation. Children with FNRFI show normal sensorimotor function and sphincter tone on anorectal manometry [8,49], although abnormal defecation dynamics are present in approximately 50% [8]. These children are often unable to relax the external anal sphincter during defecation, which is hypothesized to be an acquired control mechanism in which after losing the first stool, these children contract the external anal sphincter to retain the rest of the stool [12]. There is no indication to routinely perform anorectal manometry in children with FI.

Screening for psychological symptoms and disorders

As mentioned, 30–50% of children with FI are affected by a comorbid emotional or behavioral disorder [5]. In a large population-based study, children with frequent FI (one or

more episodes per week) had significantly increased rates of separation anxiety (4.3%), specific phobias (4.3%), generalized anxiety (3.4%), attention deficit hyperactivity disorder (ADHD) (9.2%) and oppositional defiant disorders (ODD) (11.9%) [4]. Children with FI show a heterogeneous pattern of both internalizing and externalizing disorders [5,50].

In some studies performed in tertiary centers, children with FC had the same rate of behavioral scores in the clinical range (CBCL questionnaire) as children with FNRFI (39% vs 44%, and 37% vs 39%, respectively) [8,51]. In a study of 1001 children in a tertiary center, 231 with FC and 137 with FNRFI, clinical behavioral symptoms (CBCL questionnaire) were more common in those with FNRFI than with FC regarding internalizing (39.5% vs 35.2%), externalizing (51.8% vs 40.4%) and total problems (58.8% vs 48.5%) [52]. Additionally, children with FNRFI had the highest rate of behavioral problems compared with all other types of incontinence.

Because of this high comorbidity rate, the International Children's Continence Society recommends screening for psychological symptoms in all children with FNRFI with validated, broadband parental questionnaires such as the Child Behavior Checklist (CBCL), the Strengths and Difficulties Questionnaire (SDQ), among others. Clinicians are encouraged to observe, explore and enquire about behavioral problems, as these have been shown to negatively affect compliance and adherence. If problem scores are present, assessment is recommended [5].

Indications for child psychological and psychiatric assessment

A full child psychological and psychiatric assessment is indicated when an emotional or behavioral disorder is suspected, and relevant problems are present. The assessment consists of a detailed history, observation, exploration, a mental state examination, additional questionnaires and standardized psychological testing. A psychological disorder should be diagnosed – or excluded – according to the ICD-10 or the DSM-5 classification systems. If a disorder is present, counseling is always indicated. In severe comorbid disorders, treatment according to evidence-based recommendations and guidelines should follow – in addition to the specific treatment of FNRFI.

Treatment

The International Children's Continence Society recommends a multimodal approach to treat FNRFI.

Education

Education and demystification are the first steps in the treatment of FNRFI. Information on prevalence, symptoms, treatment options, and prognosis should be provided. When discussing the subject of FI, a nonaccusatory approach is key [10,12,53].

Toilet program

Instituting a toileting program is considered to be the most essential element in the treatment of FNRFI [12,53,54]. This involves sitting on the toilet for 5–10 min after each meal to attempt to defecate. By going to the toilet after a meal, the child takes advantage of the gastrocolic reflex, which increases colonic motility upon gastric distension, facilitating defecation. The importance of a relaxed posture, with foot support for small children if needed, should be advocated. The atmosphere should be stress-free, positive, and relaxed. During these 'toilet sits' the child should try, although not be required to defecate or urinate. An extra toilet 'sit' right after school can be introduced, since most children experience episodes of fecal incontinence in the afternoon. A toilet program teaches children to take time to defecate, and helps them recognize the sensation of urge. In addition, it is important that children are instructed to go to the toilet the moment they feel the urge to defecate. Maintaining this toileting program may prove to be difficult for many as noncompliance is a considerable problem, especially in children with externalizing behavioral disorders such as ODD and ADHD. However, if the child personally completes a daily bowel diary and has a reward system in place, compliance may be increased [50].

Reward system and daily bowel diary

Rewarding toilet visits is common practice in the treatment of FC to increase a child's adherence to a toilet program [55]. Two case reports of children with FNRFI have shown that rewarding toilet sits can be effective in reducing FI frequency [56,57]. Rewarding periods without FI can be discouraging, as most episodes of FNRFI occur involuntarily.

Since the recall of bowel patterns may be unreliable, it is important to keep a daily bowel diary (e.g. for 14 days) to gain insight into the FI problem [27,58,59]. This diary may help to objectify defecation patterns, track improvement, and gain insight in therapy compliance [50].

Pharmacotherapy

A randomized, controlled trial (RCT) has shown that, unlike in the treatment of constipation-associated FI, the use of oral laxatives in children with FNRFI is not indicated [20]. Using oral laxatives may even increase the fecal incontinence frequency by making the stools too soft to retain.

There is anecdotal evidence that loperamide may have a beneficial role in the treatment of FNRFI [60]. Loperamide is an opiate receptor agonist, which decreases peristalsis and increases the internal anal sphincter tone. It is hypothesized that it improves sphincter function and thereby prevents involuntary loss of stools. If loperamide is prescribed, careful supervision is essential to prevent constipation.

A small case series of three patients has shown that the antidepressant imipramine may also have a beneficial role

in treating FNRFI [61]. Imipramine has an anticholinergic action, which decreases motility and increases sphincter tone. Its mechanism of action may be similar to that of loperamide. However, due to cardiovascular side effects, tricyclic antidepressants should not be given routinely – and only under close clinical supervision.

Enemas and rectal irrigation

Evacuating the rectum on a regular basis may decrease the chance of losing stools in the underwear. In an RCT conducted in FNRFI patients, children received conventional therapy alone or combined with daily enemas for 2 weeks [62]. During the active treatment period, clinical improvement was greater in the group receiving enemas compared with controls. However, this difference in outcome between the two groups did not persist throughout follow-up, possibly due to the short duration of treatment.

Transanal irrigation is a technique that has been proven to be effective and safe in children with constipation-associated fecal incontinence and fecal incontinence with organic causes [63,64]. However, evidence involving the effect of transanal irrigation in children with FNRFI is lacking.

Counseling and treatment of comorbid psychological disorders

Counseling is an active process engaging both parents and children. It is defined as providing assistance and guidance in resolving personal, social, or psychological difficulties. In addition to verbal counseling, other techniques can be helpful, such as ‘demonstration’, ‘coaching’, ‘modeling’ and ‘role-playing’. Counseling is important and effective in children with a manifest psychological disorder, as well as subclinical symptoms in children with FNRFI (i.e. from the age of 4 years onwards) [5,59].

Therapy is only indicated if the disorder is severe and incapacitating. Therapy includes psychotherapy, such as cognitive behavioral therapy (CBT), family and psychodynamic therapy. For some disorders, such as ADHD, pharmacotherapy with stimulants is very effective. In depression, selective serotonin reuptake inhibitors (SSRIs) can be indicated, especially in adolescents. The type of therapy should be based on an exact diagnosis and follow evidence-based principles [5,58].

Group therapy programs

Group therapy programs have been developed for children with refractory urinary and/or fecal incontinence (i.e. those who cannot be adequately treated with standard therapy) [50]. Provision of information, relaxation techniques, cognitive behavioral therapy, emotion regulation, and stress management techniques are combined, and child-friendly materials are provided. In the bowel sessions, the anatomy and physiology of the GI-tract, the causes of fecal incontinence, the importance of toilet training, diet, drinking habits and exercise are addressed.

First pre-post-analyses have shown that not only is the frequency of FI episodes reduced, but also the presence of concomitant behavioral problems [65].

Cognitive behavioral therapy

Cognitive behavioral therapy is a subtype of psychotherapy that has been shown to be effective for many disorders. It consists of two components: cognitive therapy and behavioral therapy. Cognitive therapy focuses on irrational, dysfunctional conditions, thoughts and beliefs. Behavioral therapy concentrates on observable behavior, which it aims to modify with a variety of techniques. These include ‘classical conditioning’, based on the co-appearance of stimulus and behavior, and ‘operant conditioning’, based on positive and negative reinforcement [59].

Cognitive behavioral therapy is highly effective in the treatment of many psychological disorders. The toilet training recommended for FNRFI is a type of cognitive behavioral therapy, which can be enhanced with simple techniques such as praise, rewards, and token systems. In children with special needs, such as intellectual disability, more detailed and specific types of cognitive behavioral therapy are needed to treat all types of incontinence [66].

Biofeedback training

Biofeedback training uses exercises and reinforcement to teach patients to control physiological processes. In FNRFI patients, biofeedback training is aimed at improving defecation dynamics and perception of the anorectal area [67–69]. An RCT has revealed that biofeedback training improves disturbed defecation dynamics in children with FNRFI; however, this did not influence treatment outcome [67]. The clinical relevance of biofeedback in the treatment of FNRFI is therefore uncertain.

Prognosis

Functional nonretentive fecal incontinence is often a long-lasting problem; treatment can prove to be quite challenging [16]. After 2 years of intensive treatment in a tertiary center, 29% of FNRFI patients were cured [14]. Most recovered before they reached adulthood; nevertheless, by 18 years of age, 15% still suffered from FI problems [14]. Regular follow-up is recommended so that children and their parents can maintain motivation and to prevent relapses. If treatment does not lead to improvement of symptoms within 6 months, the ICCS recommends that a child should be referred to a pediatric gastroenterologist for further evaluation and treatment. A flowchart regarding evaluation and management of children with fecal incontinence is provided (Fig. 1).

Conclusions

Of all children presenting with FI, approximately 20% may be attributed to FNRFI. Functional nonretentive fecal incontinence is a frustrating, long-lasting functional defecation

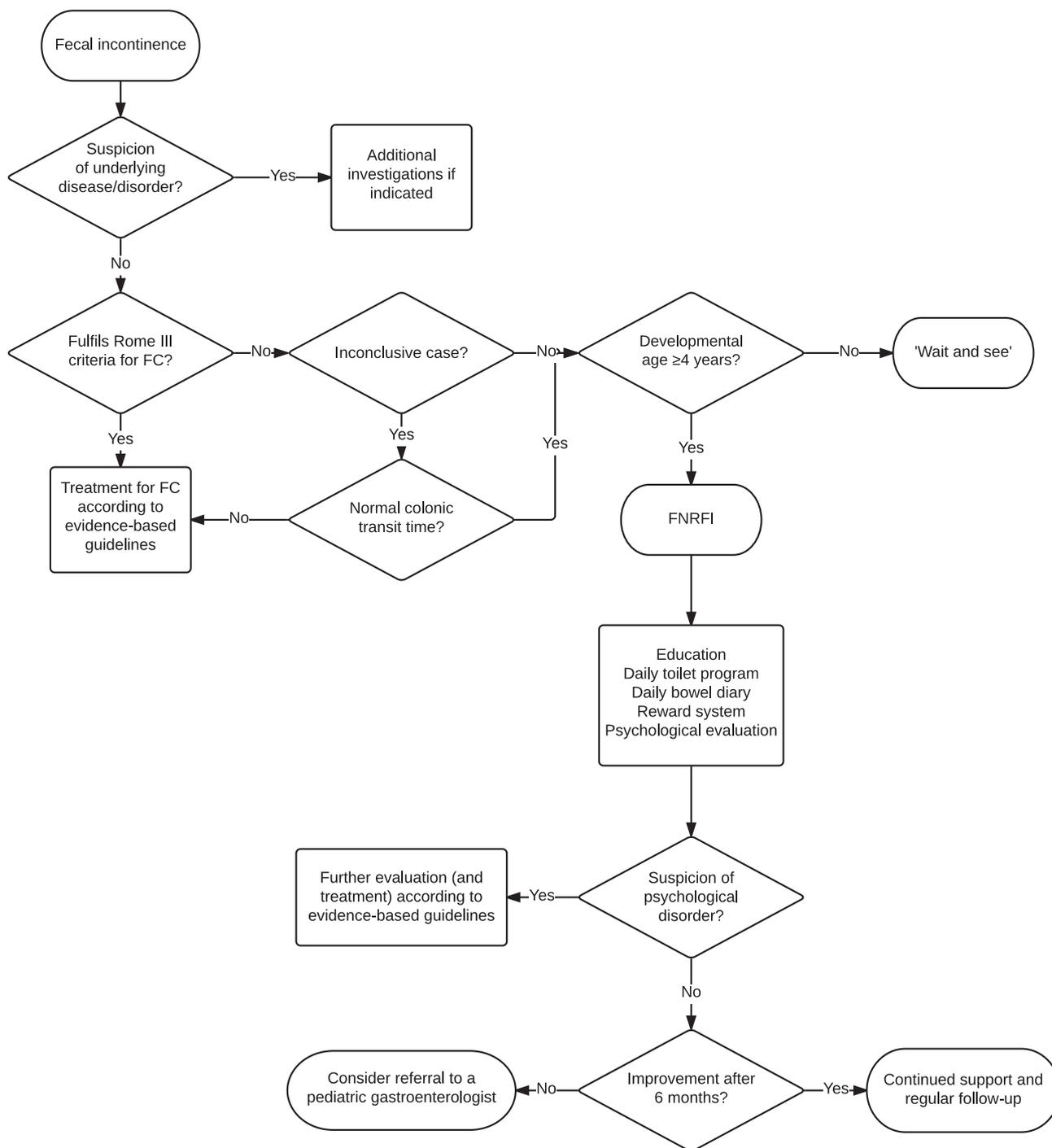


Figure 1 Algorithm for the evaluation and treatment of functional nonretentive fecal incontinence. FC, functional constipation; FNRFI, functional nonretentive fecal incontinence.

disorder. It is a clinical diagnosis based on medical history and physical examination. Determining CTT may prove useful in the diagnosis of FNRFI, yet other additional investigations are seldom needed. Treatment mainly consists of education, a nonaccusatory approach, and, most of all, a toileting program (with a daily bowel diary and a reward system). In children with FNRFI, special attention should be paid to psychosocial or behavioral problems, since these frequently occur in this patient group.

Conflict of interest/Funding

None.

Multiple-choice questions

Q1. It is important to differentiate between FNRFI and constipation-associated FI because:

- A. All children with FNRFI should receive an extensive workup with diagnostic tests
 - B. A toilet program is only recommended for children with FNRFI
 - C. The pharmacological treatment of these disorders is different
- Q2. A 5-year-old boy is presented with fecal incontinence, 3-4 times per week. He has stools every other day and the consistency is variable. He holds his stools when he is in school, because he dislikes going to public bathrooms. This boy probably has:
- A. Functional constipation with overflow incontinence
 - B. Functional nonretentive fecal incontinence
 - C. Behavioral disorder
- Q3. Which of the following investigations is most helpful in the diagnostic workup of a child suspected of FNRFI?
- A. Anorectal manometry
 - B. Colonic manometry
 - C. Colonic transit time measurement with radio-opaque markers
 - D. Rectal barostat
- Q4. Children with urinary incontinence fulfill the Rome III criteria for FNRFI in:
- A. 1% of cases
 - B. 11% of cases
 - C. 50% of cases
- Q5. What should a doctor tell a child and their parents about the prognosis of FNRFI?
- A. 80% recover within 2 years after diagnosis
 - B. 60% recover within 2 years after diagnosis
 - C. 30% recover within 2 years after diagnosis

References

- [1] Rasquin A, Di Lorenzo C, Forbes D, Guiraldes E, Hyams JS, Staiano A, et al. Childhood functional gastrointestinal disorders: child/adolescent. *Gastroenterology* 2006;130(5):1527–37.
- [2] Voskuijl WP, van der Zaag-Loonen HJ, Ketel IJ, Grootenhuys MA, Derkx BH, Benninga MA. Health related quality of life in disorders of defecation: the defecation disorder list. *Arch Dis Child* 2004;89(12):1124–7.
- [3] Bongers MEJ, Benninga MA, Maurice-Stam H, Grootenhuys MA. Health-related quality of life in young adults with symptoms of constipation continuing from childhood into adulthood. *Health Qual Life Outcomes* 2009;7:20.
- [4] Joinson C, Heron J, Butler U, von Gontard A. Psychological differences between children with and without soiling problems. *Pediatrics* 2006;117(5):1575–84.
- [5] Von Gontard A, Baeyens D, Van Hoecke E, Warzak WJ, Bachmann C. Psychological and psychiatric issues in urinary and fecal incontinence. *J Urol* 2011;185(4):1432–6.
- [6] Bongers MEJ, Benninga MA. Functional fecal incontinence in children. *Ann Nestle* 2007;65(2):81–8.
- [7] Rajindrajith S, Devanarayana NM, Benninga MA. Review article: faecal incontinence in children: epidemiology, pathophysiology, clinical evaluation and management. *Aliment Pharmacol Ther* 2013;37(1):37–48.
- [8] Benninga MA, Buller HA, Heymans HS, Tytgat GN, Taminiu JA. Is encopresis always the result of constipation? *Arch Dis Child* 1994;71(3):186–93.
- [9] Bellman M. Studies on encopresis. *Acta Paediatr Scand* 1966 Jan;(Suppl. 170). 1+.
- [10] Di Lorenzo C, Benninga MA. Pathophysiology of pediatric fecal incontinence. *Gastroenterology* 2004;126(1):S33–40.
- [11] Rajindrajith S, Devanarayana NM, Benninga MA. Constipation-associated and nonretentive fecal incontinence in children and adolescents: an epidemiological survey in Sri Lanka. *J Pediatr Gastroenterol Nutr* 2010;51(4):472–6.
- [12] Bongers ME, Tabbers MM, Benninga MA. Functional non-retentive fecal incontinence in children. *J Pediatr Gastroenterol Nutr* 2007;44(1):5–13.
- [13] Van der Wal MF, Benninga MA, Hirasing RA. The prevalence of encopresis in a multicultural population. *J Pediatr Gastroenterol Nutr* 2005;40(3):345–8.
- [14] Voskuijl WP, Reitsma JB, van Ginkel R, Buller HA, Taminiu JA, Benninga MA. Longitudinal follow-up of children with functional nonretentive fecal incontinence. *Clin Gastroenterol Hepatol* 2006;4(1):67–72.
- [15] Fishman L, Rappaport L, Cousineau D, Nurko S. Early constipation and toilet training in children with encopresis. *J Pediatr Gastroenterol Nutr* 2002;34(4):385–8.
- [16] Burgers R, Benninga MA. Functional nonretentive fecal incontinence in children: a frustrating and long-lasting clinical entity. *J Pediatr Gastroenterol Nutr* 2009;48(Suppl. 2):S98–100.
- [17] Blum NJ, Taubman B, Nemeth N. Why is toilet training occurring at older ages? A study of factors associated with later training. *J Pediatr* 2004;145(1):107–11.
- [18] Taubman B. Toilet training and toileting refusal for stool only: a prospective study. *Pediatrics* 1997;99(1):54–8.
- [19] Schum TR, McAuliffe TL, Simms MD, Walter JA, Lewis M, Pupp R. Factors associated with toilet training in the 1990s. *Ambul Pediatr* 2001;1(2):79–86.
- [20] Van Ginkel R, Benninga MA, Blommaert PJE, Van Der Plas RN, Boeckxstaens GE, Buller HA, et al. Lack of benefit of laxatives as adjunctive therapy for functional nonretentive fecal soiling in children. *J Pediatr* 2000;137(6):808–13.
- [21] Burgers R, de Jong TP, Visser M, Di Lorenzo C, Dijkgraaf MG, Benninga MA. Functional defecation disorders in children with lower urinary tract symptoms. *J Urol* 2012;189(5):1886–91.
- [22] Burgers R, Hoppenbrouwers C, Bongers ME, Lorijn De F, Voskuijl WP, Van Den Berg MM, et al. Functional nonretentive fecal incontinence, do enemas help? *Gastroenterology* 2010; 1:S357.
- [23] Borch L, Hagstroem S, Bower WF, Siggaard Rittig C, Rittig S. Bladder and bowel dysfunction and the resolution of urinary incontinence with successful management of bowel symptoms in children. *Acta Paediatr* 2013;102(5):e215–20.
- [24] Bael AM, Benninga MA, Lax H, Bachmann H, Janhsen E, De Jong TPVM, et al. Functional urinary and fecal incontinence in neurologically normal children: symptoms of one “functional elimination disorder”? *BJU Int* 2007;99(2):407–12.
- [25] Austin PF, Bauer SB, Bower W, Chase J, Franco I, Hoebeke P, et al. The standardization of terminology of lower urinary tract function in children and adolescents: update report from the standardization committee of the International Children’s Continence Society. *Neurourol Urodyn* 2015 Mar 14. <http://dx.doi.org/10.1002/nau.22751>. [Epub ahead of print].
- [26] Benninga MA, Voskuijl WP, Taminiu JAJM. Childhood constipation: is there new light in the tunnel? *J Pediatr Gastroenterol Nutr* 2004;39(5):448–64.
- [27] Van Der Plas RN, Benninga MA, Redekop WK, Taminiu JA, Buller HA. How accurate is the recall of bowel habits in children with defaecation disorders? *Eur J Pediatr* 1997; 156(3):178–81.
- [28] Mellon MW, Whiteside SP, Friedrich WN. The relevance of fecal soiling as an indicator of child sexual abuse: a preliminary analysis. *J Dev Behav Pediatr* 2006;27(1):25–32.

- [29] Morrow J, Yeager CA, Lewis DO. Encopresis and sexual abuse in a sample of boys in residential treatment. *Child Abuse Negl* 1997;21(1):11–8.
- [30] Yildirim A, Uluocak N, Atilgan D, Ozcetin M, Erdemir F, Boztepe O. Evaluation of lower urinary tract symptoms in children exposed to sexual abuse. *Urol J* 2011;8(1):38–42.
- [31] Ellsworth PI, Merguerian PA, Copening ME. Sexual abuse: another causative factor in dysfunctional voiding. *J Urol* 1995;153(3 Pt 1):773–6.
- [32] McCann J, Voris J. Perianal injuries resulting from sexual abuse: a longitudinal study. *Pediatrics* 1993;91(2):390–7.
- [33] Lahoti SL, McClain N, Girardet R, McNeese M, Cheung K. Evaluating the child for sexual abuse. *Am Fam Physician* 2001;63(5):883–92.
- [34] De Lorijn F, van Wijk MP, Reitsma JB, van Ginkel R, Taminau JAJM, Benninga MA. Prognosis of constipation: clinical factors and colonic transit time. *Arch Dis Child* 2004;89(8):723–7.
- [35] Burgers R, de Jong TPVM, Benninga MA. Rectal examination in children: digital versus transabdominal ultrasound. *J Urol* 2013;190(2):667–72.
- [36] Benninga MA, Wijers OB, van der Hoeven CW, Taminau JA, Klopper PJ, Tytgat GN, et al. Manometry, profilometry, and endosonography: normal physiology and anatomy of the anal canal in healthy children. *J Pediatr Gastroenterol Nutr* 1994;18(1):68–77.
- [37] Joensson IM, Siggaard C, Rittig S, Hagstroem S, Djurhuus JC. Transabdominal ultrasound of rectum as a diagnostic tool in childhood constipation. *J Urol* 2008;179(5):1997–2002.
- [38] Singh SJ, Gibbons NJ, Vincent MV, Sithole J, Nwokoma NJ, Alagarswami KV. Use of pelvic ultrasound in the diagnosis of megarectum in children with constipation. *J Pediatr Surg* 2005;40(12):1941–4.
- [39] Bijoś A, Czerwionka-Szaflarska M, Mazur A, Romańczuk W. The usefulness of ultrasound examination of the bowel as a method of assessment of functional chronic constipation in children. *Pediatr Radiol* 2007;37(12):1247–52.
- [40] Klijn AJ, Asselman M, Vijverberg MAW, Dik P, de Jong TPVM. The diameter of the rectum on ultrasonography as a diagnostic tool for constipation in children with dysfunctional voiding. *J Urol* 2004;172(5 Pt 1):1986–8.
- [41] Lakshminarayanan B, Kufeji D, Clayden G. A new ultrasound scoring system for assessing the severity of constipation in children. *Pediatr Surg Int* 2008;24(12):1379–84.
- [42] Tabbers MM, Di Lorenzo C, Berger MY, Faure C, Langendam MW, Nurko S, et al. Evaluation and treatment of functional constipation in infants and children: evidence-based recommendations from ESPGHAN and NASPGHAN. *J Pediatr Gastroenterol Nutr* 2014;58(2):258–74.
- [43] Berger MY, Tabbers MM, Kurver MJ, Boluyt N, Benninga MA. Value of abdominal radiography, colonic transit time, and rectal ultrasound scanning in the diagnosis of idiopathic constipation in children: a systematic review. *J Pediatr* 2012;161(1):44–50. e1–2.
- [44] Benninga MA, Buller HA, Staalman CR, Gubler FM, Bossuyt PM, van der Plas RN, et al. Defaecation disorders in children, colonic transit time versus the Barr-score. *Eur J Pediatr* 1995;154(4):277–84.
- [45] Bekkali N-L-H, Hagebeuk EEO, Bongers MEJ, van Rijn RR, Van Wijk MP, Liem O, et al. Magnetic resonance imaging of the lumbosacral spine in children with chronic constipation or non-retentive fecal incontinence: a prospective study. *J Pediatr* 2010;156(3):461–5.
- [46] Van den Berg MM, Di Lorenzo C, van Ginkel R, Mousa HM, Benninga MA. Barostat testing in children with functional gastrointestinal disorders. *Curr Gastroenterol Rep* 2006;8(3):224–9.
- [47] Voskuilj WP, Van Ginkel R, Benninga MA, Hart GA, Taminau JAJM, Boeckxstaens GE. New insight into rectal function in pediatric defecation disorders: disturbed rectal compliance is an essential mechanism in pediatric constipation. *J Pediatr* 2006;148(1):62–7.
- [48] Van den Berg MM, Bongers MEJ, Voskuilj WP, Benninga MA. No role for increased rectal compliance in pediatric functional constipation. *Gastroenterology* 2009;137(6):1963–9.
- [49] Molnar D, Taitz LS, Urwin OM, Wales JK. Anorectal manometry results in defecation disorders. *Arch Dis Child* 1983;58(4):257–61.
- [50] Equit M, Sambach H, Niemczyk J, Gontard A von. Urinary and fecal incontinence: a training program for children and adolescents. Boston: Hogrefe Publishing; 2015. p. 209.
- [51] Benninga MA, Voskuilj WP, Akkerhuis GW, Taminau JA, Buller HA. Colonic transit times and behaviour profiles in children with defecation disorders. *Arch Dis Child* 2004;89(1):13–6.
- [52] Von Gontard A, Niemczyk J, Weber M, Equit M. Specific behavioral comorbidity in a large sample of children with functional incontinence: report of 1,001 cases. *Neurourol Urodyn* 2015;34(8):763–8.
- [53] Borowitz SM, Cox DJ, Sutphen JL, Kovatchev B. Treatment of childhood encopresis: a randomized trial comparing three treatment protocols. *J Pediatr Gastroenterol Nutr* 2002;34(4):378–84.
- [54] Pensabene L, Nurko S. Management of fecal incontinence in children without functional fecal retention. *Curr Treat Options Gastroenterol* 2004;7(5):381–90.
- [55] Koppen IJN, Lammers LA, Benninga MA, Tabbers MM. Management of functional constipation in children: therapy in practice. *Paediatr Drugs* 2015;17(5):349–60.
- [56] Boles RE, Roberts MC, Vernberg EM. Treating non-retentive encopresis with rewarded scheduled toilet visits. *Behav Anal Pract* 2008;1(2):68–72.
- [57] Kuhn BR, Marcus BA, Pitner SL. Treatment guidelines for primary nonretentive encopresis and stool toileting refusal. *Am Fam Physician* 1999;59(8):2171–8.
- [58] von Gontard A. Encopresis. In: Rey J, editor. *IACAPAP Textbook of Child and Adolescent Mental Health*, online; 2012. <http://iacapap.org/iacapap-textbook-of-child-and-adolescent-mental-health>.
- [59] Von Gontard A, Neveus T. Management of disorders of bladder and bowel control in childhood. Management of disorders of bladder and bowel control in childhood. London: MacKeith Press; 2006.
- [60] Voskuilj WP, Van Ginkel R, Taminau JA, Boeckxstaens GE, Benninga MA. Loperamide suppositories in an adolescent with childhood-onset functional non-retentive fecal soiling. *J Pediatr Gastroenterol Nutr* 2003;37(2):198–200.
- [61] Gavanski M. Treatment of non-retentive secondary encopresis with imipramine and psychotherapy. *Can Med Assoc J* 1971;104(1):46–8.
- [62] Burgers R, Reitsma JB, Bongers ME, de Lorijn F, Benninga MA. Functional nonretentive fecal incontinence: do enemas help? *J Pediatr* 2012;162(5):1023–7.
- [63] Corbett P, Denny A, Dick K, Malone PS, Griffin S, Stanton MP. Peristeen integrated transanal irrigation system successfully treats faecal incontinence in children. *J Pediatr Urol* 2014;10(2):219–22.
- [64] Nasher O, Hill RE, Peeraully R, Wright A, Singh SJ. Peristeen® transanal irrigation system for paediatric faecal incontinence: a single centre experience. *Int J Pediatr* 2014;954315.

- [65] Sambach H, Equit M, El Khatib D, Schreiner-Zink S, Von Gontard A. Therapieresistente Harninkontinenz und Enuresis: Gruppenblasenschulung. *Monatsschrift Kinderheilkd* 2011;159: 565–71.
- [66] Von Gontard A. Urinary incontinence in children with special needs. *Nat Rev Urol* 2013;10(11):667–74.
- [67] Van der Plas RN, Benninga MA, Redekop WK, Taminiau JA, Buller HA. Randomised trial of biofeedback training for encopresis. *Arch Dis Child* 1996;75(5):367–74.
- [68] Loening-Baucke V. Modulation of abnormal defecation dynamics by biofeedback treatment in chronically constipated children with encopresis. *J Pediatr* 1990;116(2):214–22.
- [69] Van der Plas R, Benninga M, Büller H, Bossuyt P, Akkermans L, Redekop W, et al. Biofeedback training in treatment of childhood constipation: a randomised controlled study. *Lancet* 1996;348(9030):776–80.