

# SPINAL CORD INJURY GUIDELINES 2023

## Department of Physical Medicine and Rehabilitation/IDHI Brain Injury Program

### TELE-REHABILITATION GUIDELINE

#### Neurogenic Bowel

Author(s):	Thomas S. Kiser	Peer Reviewed:		Finalized:	
Drafted:	June 2014	Date:	2023	Published:	June 2018

#### I. Definition, assessment, and diagnosis

##### A. Definition: Neurogenic Bowel

1. Impairment of gastrointestinal and anorectal function resulting from impaired input from the central nervous system as the result of a spinal cord injury (SCI)<sup>1</sup>
  - a. Complications include but are not limited to ileus, gastric ulcers, gastroesophageal reflux disease (GERD), autonomic dysreflexia (AD), hemorrhoids, abdominal distention, diverticulosis, nausea, appetite loss, bowel impaction, constipation, delayed evacuation and unplanned evacuation.
  - b. The most likely cause of hospitalization due to complications of a neurogenic bowel is bowel impaction and/or an Ileus.
  - c. The complications due to neurogenic bowel can cause major physical and psychological problems in SCI persons and therefore must be managed in a proactive manner by the patient, the family/care giver and the health care provider.
2. Neurogenic bowel can be classified as Upper Motor Neuron (UMN) or Lower Motor Neuron (LMN) bowel dysfunction.<sup>2</sup>
  - a. UMN: Supraconal (suprasacral) Injury above the conus medullaris
    - 1) Hyperreflexic bowel characterized by increased colonic wall and anal tones
    - 2) Voluntary control of the external anal sphincter is disrupted, and the sphincter remains tight, thus promoting retention of stool. However, nerve connection between the spinal cord and colon remain intact, with preserved reflex coordination and stool propulsion.
    - 3) Stool evacuation can be achieved by eliciting reflex activity from introducing a stimulus into the rectum, such as an irritant or digital stimulation.
    - 4) The goal is to maintain soft yet firm stool, evacuate on a routine basis (at least 3 times per week) and prevent accidents.
  - b. LMN: Conal/Infraconal Injury at the conus medullaris and/or cauda equina
    - 5) Areflexic bowel characterized by loss of centrally mediated spinal cord peristalsis and slow stool propulsion
    - 6) Damage at or below T12 will inhibit the spinal cord mediated reflex defecation and will not respond to stimulation.
    - 7) Commonly associated with constipation and significant risk of incontinence because of the atonic external anal sphincter and lack of control over the levator ani muscle
    - 8) The goal is to maintain well-formed stool, maintain clear rectal vault and prevent accidents.
3. The colon is supplied with both autonomic (parasympathetic and sympathetic) and somatic (ie, sensory and motor) pathways.<sup>3</sup> Balance between these distinct neural pathways is controlled by higher centers in the brain and spinal cord.<sup>4</sup>
  - a. The GI tract is intrinsically innervated by the enteric nervous system (ENS) which consists of Auerbach's intramuscular myenteric plexus and Meissner's submucosal plexus<sup>5</sup>. Activity within the ENS can be modified by portions of the sympathetic nervous system (SNS), parasympathetic nervous system (PNS), and

# SPINAL CORD INJURY GUIDELINES 2023

## Department of Physical Medicine and Rehabilitation/IDHI Brain Injury Program

- somatic nervous system; normal defecation requires coordination between each entity.
- b. Parasympathetic innervation of the colon is responsible for colonic contractions and motility. The right and proximal transverse colon is innervated through the vagus nerve, whereas the left colon and rectum receives neural input from spinal segments S2-S4 via the pelvic nerve or nervi erigentes.
  - c. Sympathetic innervation to the descending colon and rectal vault is provided by the hypogastric nerve that arises from the T12-L3 segments of the spinal cord. <sup>6</sup>The neuromuscular innervation of the colon is coordinated to produce both non-propulsive segmental contractions and high amplitude propagating contractions. Various neurotransmitters including acetylcholine, catecholamines, and serotonin have been shown to regulate colonic motility, although the principal autonomic neurotransmitter is acetylcholine. <sup>7</sup>
4. Neurogenic bowel awareness and function is determined by whether the patient is a complete or incomplete SCI.
    - a. Those with incomplete injury may retain the sensation of rectal fullness and the ability to evacuate bowels, so no specific bowel program may be required.
    - b. Those with a complete injury will have impaired bowel awareness and the ability to control evacuation of the distal colon will depend on whether or not the reflex arc is maintained.
- B. Assessment and diagnosis <sup>1</sup>
1. A systemic, comprehensive evaluation of bowel function, impairment, and possible problems should be completed at the onset of SCI and at least annually.
  2. Patient history should include:
    - a. Premorbid gastrointestinal function and general medical conditions
    - b. Current bowel program
    - c. Current symptoms including abdominal distention, respiratory compromise, early satiety, nausea, evacuation difficulty, unplanned evacuations, rectal bleeding, diarrhea, constipation and pain
    - d. Defecation or bowel care frequency, duration and characteristics of stool
  3. A physical examination should be completed at onset of SCI and annually throughout care and should include:
    - a. Complete abdominal assessment including palpation along the colon
    - b. Rectal examination
    - c. Assessment of anal sphincter tone
    - d. Testing for anocutaneous and bulbocavernous reflexes to differentiate UMN vs. LMN bowel
    - e. Stool testing for occult blood or colonoscopy screening beginning at age 50, as the incidence of colon cancer is very similar to the non-disabled population. <sup>8 9</sup>
  4. Assessment of knowledge, cognition, function and performance should be conducted in order to determine an individual's ability to independently perform bowel program or direct a caregiver safely and effectively. This assessment should include the patient's:
    - a. Ability to learn
    - b. Ability to direct others
    - c. Sitting tolerance, angle and balance
    - d. Upper extremity strength and proprioception
    - e. Hand and arm function
    - f. Spasticity
    - g. Transfer capabilities
    - h. Actual and potential risks to skin

- i. Home accessibility and equipment needs

## II. Management and treatment recommendations

### A. Management/treatment

1. Designing a good bowel program requires appropriate hydration, diet, activity, and choice of rectal stimulant to trigger defecation. Bowel program is initially daily but can be changed to every other day or 3x a week. It is important to individualize programs to find the optimal schedule, body position (in the bed, on the toilet, or over a bedside commode) and appropriate assistive techniques. Evaluate medications for adverse effects on the bowels.
2. Whenever possible, bowel care initiated for evacuation should be performed in either the normal position or in the left lateral position<sup>10</sup>. This allows use of gravity and facilitates fecal expulsion. Digital rectal stimulation is also useful for promoting bowel evacuation.<sup>11 12</sup>
3. Rectal stimulation may be necessary and can be used either individually or in combination.
  - a. Mechanical methods
    - 1) Digital stimulation: Increases peristalsis and relaxes the external anal sphincter in UMN bowel. It is done by inserting a lubricated gloved finger into the rectum and rotating in a circular manner. Should be done for 15-20 seconds, with stimulation longer than 1 minute usually being unnecessary.
    - 2) Manual evacuation involves the insertion of one or two lubricated gloved fingers into the rectum to unhook stool and is the method of choice for patients with LMN bowel.
    - 3) Transanal irrigation is an excellent option for rectal evacuation in both hyperreflexic and hyporeflexic NB. The transanal irrigation device (e.g., Peristeen™, Navina™) includes a rectal balloon catheter and a pump which can provide pulsed irrigation to cleanse the rectum up to the sigmoid.<sup>13</sup>
  - b. Chemical methods
    - 1) Glycerin suppositories act as a mild local stimulant and lubricating agent. Use in patients who experience adverse reactions to bisacodyl suppositories, fast reactions to bisacodyl or are attempting to make a transition from suppository to mechanical stimulation.
    - 2) Bisacodyl suppository is a contact irritant, acting directly on the mucosa and elicits peristalsis along the entire colon. The Polyethylene based bisacodyl suppositories (Magic bullet) are known to melt faster and work more quickly than the hydrogenated vegetable oil-based bisacodyl suppositories (dulcolax suppository)
    - 3) Mini-enemas are a 4 mL liquid suppository composed of liquid docusate and glycerin. They trigger reflex mediated peristalsis by acting as a mucosal stimulant and by providing lubrication.
    - 4) Mini-enemas with 3-5 ml liquid soap or shampoo with a 5 cc syringe made as a home preparation can be successful and cheaper.
  - c. The goal of the bowel program is to minimize or avoid unplanned bowel evacuations. Thus, the program should be predictable, scheduled and provide effective elimination to avoid colonic distention and fecal impaction.
  - d. A bowel program will require frequent adjustments throughout an individual's lifetime. During the acute phase of care, the spinal cord is in shock with impairment of the reflex arcs. There will be a need for more vigorous rectal

# SPINAL CORD INJURY GUIDELINES 2023

## Department of Physical Medicine and Rehabilitation/IDHI Brain Injury Program

- stimulation and/or manual evacuation during the first few days of injury. As the individual's activity level increases and they experiment with different positioning, fluid amounts and diet, the patient will need to make further adjustments. In an incomplete SCI full recovery of bowel function may return and the necessity of the bowel program may resolve.
- e. Consider also the use of assistive techniques that increase abdominal pressure: such as body push-ups; abdominal massage in a clockwise manner (starting the right lower abdominal quadrant moving up the ascending colon, across the transverse colon, and down the descending colon); the Valsalva maneuver; deep breathing; ingestion of warm fluids; and/or a seated, forward leaning position to aid in bowel emptying.
  - f. Knowledge of complications due to inadequate bowel program are necessary for prompt diagnosis as patients with SCI often have diminished visceral sensations and other clinical/physical signs which are usually relied on for a correct diagnosis. For instance, individuals with injuries above T6 may present with signs or symptoms of autonomic dysreflexia, vague non-localized discomfort, increased spasticity and a distended and taut abdomen. Keep in mind that the most common complaint in SCI patients with abdominal pathology is anorexia +/- autonomic dysreflexia (if level of SCI at or above T6) and +/- pain.
  - g. Constipation in patients with SCI manifests with unusually long bowel care periods, abdominal distention, increased belching and small amounts of hard and dry stools. Management of chronic constipation begins with investigation of diet, fluid and fiber intake, daily activity and minimization of medications that can contribute to constipation. If proper evacuation is not obtained in 24 hours after a regular bowel program then a trial of one or more of lubricants, osmotic laxatives and stimulant cathartics should be attempted. If this is a chronic problem addition of a routine laxative such as polyethylene glycol (miralax), oral magnesium supplement, lubiporstone (Amitiza), or linaclotide (Linzess) can be helpful.
  - h. Diarrhea in the presence of UMN bowel is usually related to overflow constipation, but can also be caused by antibiotic use, GI infections, over-activation of secretomotor neurons by histamine from inflammatory and immune mediated cells in the mucosa and submucosa, and/or vasoactive intestinal peptide and serotonin from mucosal enterochromaffin cells. These chemicals in turn affect presynaptic inhibitory receptors, impeding the release of norepinephrine from postganglionic sympathetic fibers that inhibit secretomotor neurons.<sup>14</sup>
  - i. Colostomies should not be considered as a failure of bowel program, but rather viewed as a safe, effective method at managing severe and chronic gastrointestinal problems.<sup>15</sup> Colostomies have been shown to reduce the number of hours spent on a bowel program, simplify bowel care, reduce the number of hospitalizations as a result of bowel care complaints, and to improve the quality of life. A colostomy can be used to decrease bacterial count and contamination of a pressure sore and aid in the healing of a pressure sore.<sup>16</sup> If colostomy is decided upon, a permanent stoma is the best option.
  - j. Anterior cecostomies (ACE) are routinely used in Spina bifida patients and placed at a young age and can help with good bowel control in a predominantly lower motor neuron bowel population. It is not routinely used in spinal cord injuries as a large population of these patients have an upper motor neuron bowel, but it is also a viable option if the bowel program is impairing the quality of life in a patient with a spinal cord injury. Malone antegrade continence enema

or Chait trapdoor cecostomy catheter which are increasingly performed in a minimally invasive fashion can be used to improve bowel care in more severe cases.<sup>17</sup> The ACE flushes the whole colon, since this is positioned in the proximal colon, and can be performed 2–3 times a week.

- k. Macedo–Malone or left-sided ACE (LACE): For people who have exceptionally slow colonic transit, this is an alternate surgical procedure, the can be performed where a portion of the descending colon is used to create a catheterizable tube attached to the left lower abdominal wall. The LACE only flushes the more distal descending colon with less cleansing, but should be performed more often, i.e., daily or every other day. The advantage of the LACE is that the catheterizable stoma can be filled with 200–600 mL of tap water to induce propulsive colonic peristalsis and defecation within 10–20 min, as opposed to the ACE in which larger amounts of water are required for flushing and can take 1–2 h to complete.<sup>18</sup>

### B. Imaging<sup>19</sup>

1. An abdominal X-ray for the evaluation of fecal loading, impaction, megacolon, intestinal obstruction, or perforation.
2. If more information is necessary, an abdominal CT scan is helpful to assess gastric, small intestinal, colonic, or pelvic structural or anatomical abnormalities. The CT's main use is to identify small or large intestinal obstruction, and can establish the cause, site, and extent of an obstruction.
3. A defecography study has the advantage of evaluating the anorectum and pelvic floor muscles before, during, and after defecation in real time with the use of fluoroscopy or magnetic resonance imaging (MRI). The response and coordination of the rectum, sphincters, and pelvic floor to the attempted defecation of barium paste instilled in the rectum (to mimic stool) can be assessed dynamically.<sup>20</sup>

### C. Restrictions

1. Caution should be used to avoid AD with digital stimulation (a pain stimulating maneuver) in patients with spinal cord lesions at or above T6. In individuals who experience AD with a bowel program, consider using a topical anesthetic gel or ointment when conducting the digital stimulation to reduce this risk or premedicate with sublingual or topical nitroglycerin (avoid in patients who are using PDE5 inhibitors medication, such as Viagra due to risk of hypotension when PDE5's are used with nitroglycerin) prior to the digital stimulation to avoid the hypertension associated with AD.
2. Due to loss of sensation, use of bedpans should be strictly prohibited due to significant risks of skin breakdown and pressure ulcer formation. If bowel care on a commode or toilet is not possible, the patient should be placed in bed with appropriate padding under his/her buttocks.
3. Colorectal cancer must be ruled out in patients with positive fecal occult blood testing or in patients who are over the age of 50 and experience a change in bowel function that does not respond to corrective measures.
4. Major outcomes: An adequate bowel program in acute care should be designed so that the patient can easily replicate it at home to minimize unplanned evacuations.

## III. Prevention and education

- A. Prevention: Diet plays a large role in a successful bowel program. Certain foods make stool hard/soft, make stool loose or produce flatulence. Monitor accordingly and consider consult with a nutritionist/dietician.

# SPINAL CORD INJURY GUIDELINES 2023

## Department of Physical Medicine and Rehabilitation/IDHI Brain Injury Program

1. Caution must be taken when adding fiber to the diet as fiber alone does not necessarily improve bowel function. Patient's previous fiber intake should be taken into consideration. The recommended starting dose is 15 g fiber/day with plans to increase slowly to goal of 25-30 g and combine with 2-3 L of fluid to prevent developing a bowel impaction<sup>21</sup>. Additional fiber in the diet can slow down the colon transit time and if not enough fluid is consumed cause constipation<sup>22</sup>.
  1. Foods with high fermentable oligosaccharides, disaccharides, monosaccharides, and polyols (FODMAPs) may lead to increased GI symptoms in neurogenic bowel dysfunction. FODMAPs raise the concentration of fructose in the excess of glucose (apples, pears), lactose (dairy products), fructans (wheat, onions), polyols (artificial sweeteners and sorbitol), and galacto-oligosaccharides (legumes, cabbage).<sup>23</sup>
  2. There are studies demonstrating constipation resolution with high prune intake (6 prunes 2x daily) attributed to fiber and fructose.<sup>24</sup>
  3. Food intake increases gut motility in non-disabled persons. A postprandial colonic response to food in subjects with SCI was demonstrated in two studies<sup>25</sup> but, postprandial colonic response in SCI was suboptimal and confined to the descending colon in another study.<sup>26</sup>, and in several studies this phenomenon was not demonstrated<sup>27 28 29</sup>. So a person's response to food intake and use of colonic reflex response in a bowel program can be variable.
  4. The amount of fluid needed to promote optimal stool consistency must balance the amount needed for appropriate bladder management.
  5. Recommended fluid intake is 500 ml/day greater than the general public. Calculated as 40 ml/kg body weight + 500 ml/day.
- B. Education
  1. Educational programs for bowel management should be structured and comprehensive. Education should be directed at all health care providers, patients and caregivers. Program timing and content will depend on medical stability, readiness to learn, safety awareness and other related factors. Educational training should include information on:
    - a. Anatomy
    - b. Process of defecation
    - c. Effect of SCI on bowel function
    - d. Description, goals and rationale of successful bowel programs
    - e. Factors that promote successful bowel programs
    - f. Role of regularity, timing and positioning in successful programs
    - g. Safe and effective use of assistive devices and adaptive equipment
    - h. Techniques for manual evacuation, digital stimulation and suppository insert
    - i. Effect of prescription and non-prescription medications on bowel function
    - j. Prevention and treatment of common bowel problems, including constipation, impaction, diarrhea, hemorrhoids, incontinence and autonomic dysreflexia
    - k. When/how to make changes in medications and medication schedules to optimize the bowel program
    - l. Management of unplanned bowel movements and how to prepare for/adjust bowel programs for natural disasters and emergencies.
  2. Patient and caregiver knowledge of bowel program management should be assessed at each of the follow-up visits.

# SPINAL CORD INJURY GUIDELINES 2023

## Department of Physical Medicine and Rehabilitation/IDHI Brain Injury Program

*This guideline was developed to improve health care access in Arkansas and to aid health care providers in making decisions about appropriate patient care. The needs of the individual patient, resources available, and limitations unique to the institution or type of practice may warrant variations.*

### Guideline Developers

Guideline developed by Gladys G Kamanga-Sollo, MD, in collaboration with the TRIUMPH team led by Thomas S Kiser, MD, and Rani H Lindberg, MD.

Updated by Thomas S. Kiser 6/10/2018.

Updated by Thomas S. Kiser 2/20/2023.

### Selected References

- <sup>1</sup> Consortium for Spinal Cord Medicine. (1998). *Neurogenic Bowel Management in Adults with Spinal Cord Injury*. Consortium for Spinal Cord Medicine. Washington, D.C.: Paralyzed Veterans of America.
- <sup>2</sup> Krassioukov, A., Eng, J.J., Claxton, G., Sakakibara, B.M., & Shum, S. (2010). Neurogenic bowel management after spinal cord injury: A systematic review of the evidence. *Spinal Cord*, 48, 718-33.
- <sup>3</sup> Adams RD, Victor M. Diseases of the spinal cord, peripheral nerve, and muscle. In: Adams RD, Victor M, eds. *Principles of Neurology*. New York: McGraw-Hill Publishers; 1993:1178-1180.
- <sup>4</sup> Bauman WA, Korsten MA, Radulovic M, Schilero GJ, Wecht JM, Spungen AM. 31st G. Heiner Sell Lectureship: Secondary Medical Consequences of Spinal Cord Injury. *Top Spinal Cord Inj Rehabil* 2012;18(4):354–378.
- <sup>5</sup> Benarroch, E.E. Physiology and Pathophysiology of the Autonomic Nervous System. *Contin. Lifelong Learn. Neurol.* 2020, 26, 12–24.
- <sup>6</sup> Wecht, J.M.; Krassioukov, A.V.; Alexander, M.; Handrakis, J.P.; McKenna, S.L.; Kennelly, M.; Trbovich, M.; Biering-Sorensen, F.; Burns, S.; Elliott, S.L.; et al. International Standards to document Autonomic Function following SCI (ISAFSCI): Second Edition. *Top. Spinal Cord Inj. Rehabil.* **2021**, 27, 23–49.
- <sup>7</sup> Cook IJ, Brookes SJ. Motility of large intestine. In: Feldman M, Friedman LS, Sleisenger MH, eds. *Gastrointestinal and Liver Disease: Pathophysiology, Diagnosis and Management*. Philadelphia: Elsevier Saunders; 2002:1679-1690.
- <sup>8</sup> Soo Jeong Han, Chung Mi Kim, Jeong Eun Lee, Tae Hoon Lee, Colonoscopic Lesions in Patients with Spinal Cord Injury. *J Spinal Cord Med.* August 2009;32(4):404–407
- <sup>9</sup> Zauber AG, Winawer SJ, O'Brien MJ, et al. Colonoscopic polypectomy and long-term prevention of colorectal-cancer deaths. *N Engl J Med.* 2012;366(8):687-696
- <sup>10</sup> American Association of Spinal Cord Injury Nurses. American Association of Spinal Cord Injury Nurses Standards of practice--revised 2003-2004. *SCI Nurs.* 2004;21(4):228-232.
- <sup>11</sup> Shafik A, El-Sibai D, Shafik I. Physiologic basis of digital rectal stimulation for bowel evacuation in patients with spinal cord injury: identification of an anorectal excitatory reflex. *J Spinal Cord Med.* 2000;23:270-275.
- <sup>12</sup> Korsten MA, Monga A, Chaparala G, et al. Digital rectal stimulation causes increased left sided colonic motility in patients with SCI. *Gastroenterology.* 2003;124:A115.
- <sup>13</sup> Rodriguez, G.; Stiens, S.A. Neurogenic Bowel: Dysfunction and Rehabilitation. In Braddom's Physical Medicine and Rehabilitation, 6th ed.; Elsevier, Inc.: Philadelphia, PA, USA, 2021; pp. 407–430.e4.
- <sup>14</sup> Wood, J.D. Neuropathophysiology of functional gastrointestinal disorders. *World J. Gastroenterol.* 2007, 13, 1313–1332.
- <sup>15</sup> Saltzstein RJ, Romano J. The efficacy of colostomy as a bowel management alternative in selected spinal cord injury patients. *J Am Paraplegia Soc.* 1990;13:9-13.
- <sup>16</sup> Stone JM, Wolfe VA, Nino-Murcia M, et al. Colostomy as treatment for complications of spinal cord injury. *Arch Phys Med Rehabil.* 1990;71:514-518.
- <sup>17</sup> Gora RA, Katorskib JR, Elliott SP. Medical and surgical management of neurogenic bowel. *Curr Opin Urol* 2016, 26:369–375.
- <sup>18</sup> Sinha, C.K.; Grewal, A.; Ward, H.C. Antegrade continence enema (ACE): Current practice. *Pediatr. Surg. Int.* 2008, 24, 685–688.

# SPINAL CORD INJURY GUIDELINES 2023

## Department of Physical Medicine and Rehabilitation/IDHI Brain Injury Program

- 
- <sup>19</sup> Rodriguez, G.M.; Gater, D.R. Neurogenic Bowel and Management after Spinal Cord Injury: A Narrative Review. *J. Pers. Med.* 2022, 12, 1141.
- <sup>20</sup> Rao, S.S.; Bharucha, A.E.; Chiarioni, G.; Felt-Bersma, R.; Knowles, C.; Malcolm, A.; Wald, A. Functional Anorectal Disorders. *Gastroenterology* 2006, 130, 1510–1518.
- <sup>21</sup> Nelson A, Malassigne P, Amerson T, et al. Descriptive study of bowel care practices and equipment in spinal cord injury. *SCI Nursing.* 1993;10:65-67.
- <sup>22</sup> Cameron KJ, Nyulasi IB, Cllier GR, et al. Assessment of the effect of increased dietary fiber intake on bowel function in patients with spinal cord injury. *Spinal Cord* 1996;34:277-283.
- <sup>23</sup> Liu, J.; Chey, W.D.; Haller, E.; Eswaran, S. Low-FODMAP Diet for Irritable Bowel Syndrome: What We Know and What We Have Yet to Learn. *Annu. Rev. Med.* 2020, 71, 303–314.
- <sup>24</sup> Lever, E.; Cole, J.; Scott, S.M.; Emery, P.W.; Whelan, K. Systematic review: The effect of prunes on gastrointestinal function. *Aliment. Pharmacol. Ther.* 2014, 40, 750–758.
- <sup>25</sup> Connell A, Frankel H, Guttman L. The motility of the pelvic colon following complete lesions of the spinal cord. *Paraplegia* 1963;1:98–115.
- <sup>26</sup> Fajardo NR, vic Pasiliao R, Duncan RM, Creasey G, Bauman WA, Korsten MA. Decreased Colonic Motility in Persons with Chronic Spinal Cord Injury. *American Journal of Gastroenterology.* Vol. 98, No. 1, 2003..
- <sup>27</sup> Glick M, Meshkinpour H, Haldeman S, et al. Colonic dysfunction in patients with thoracic spinal cord injury. *Gastroenterology* 1984;86:287–94.
- <sup>28</sup> Bruninga K, Camilleri M. Colonic motility and tone after spinal cord and cauda equina injury. *Am J Gastroenterol* 1997;92:891–4.
- <sup>29</sup> Aaronson M, Freed M, Burakoff R. Colonic myoelectric activity in persons with spinal cord injury. *Dig Dis Sci* 1985; 30:295–300.