

Temperature-controlled radiofrequency energy (SECCA) to the anal canal for the treatment of faecal incontinence offers moderate improvement

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Background and aim Faecal incontinence is a devastating complaint. Even after conservative treatment, many patients still remain incontinent. Few patients have a sphincter defect suitable for repair. Other emerging surgical therapies like dynamic gracilis plasty, neuromodulation or artificial bowel sphincter, carry side effects and show only moderate improvement. Temperature-controlled radiofrequency energy (SECCA) has shown promising results in the USA. Local tightening seems to be the mode of action with possible increased rectal sensitivity. We investigated the effectiveness of radiofrequency and possible changes in the anal sphincter with 3D-ultrasound in patients with faecal incontinence.

Patients and methods Eleven women, mean age 61 years (49–73) with long-standing faecal incontinence were included. Patients with large sphincter defects and anal stenosis were excluded. The SECCA procedure was performed under conscious sedation and local anaesthesia. Oral antibiotics were given. In four quadrants on four or five levels (depending upon length of the anus) radiofrequency was delivered with multiple needle electrodes. Patients were evaluated at 0, 6 weeks, 3 and 6 months and 1 year. Three-dimensional anal ultrasound was performed at 0 (before and after the procedure), 6 weeks and 3 months. Anal manometry and rectal compliance measurement were performed at 0 and 3 months.

Results At 3 months, six of 11 patients improved, which persisted during follow-up of 1 year. The Vaizey score

changed from 18.8 to 15.0 ($P=0.03$) and in those improved from 18.3 to 11.5 ($P=0.03$). Anal manometry and rectal compliance showed no significant changes, there was a tendency to increased rectal sensitivity concerning urge and maximal tolerated volume (both $P=0.3$). Responders compared with nonresponders showed no difference in test results. Side effects were local haematoma (2), bleeding 3 days (1), pain persisting 1–3 weeks (4) and laxatives-related diarrhoea during 1–3 weeks (4).

Conclusion The SECCA procedure seems to be promising for patients with faecal incontinence with a persisting effect after 1 year. No significant changes in tests were found. *Eur J Gastroenterol Hepatol* 19:575–580 © 2007 Lippincott Williams & Wilkins.

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Introduction

Faecal incontinence is a complex problem that has a high impact on the quality of life [1]. Damage to the anal sphincters (external and/or internal anal sphincter defect) or to the pudendal nerve (denervation) during vaginal delivery is the most frequently encountered cause in women with faecal incontinence. Anal sphincter trauma and damage of the pudendal nerve often occur simultaneously [2].

The exact incidence of faecal incontinence is hard to determine and relates to the reluctance to report this complaint because of embarrassment. Several studies with questionnaires in the general population report prevalence up to 7%, increasing with age [3].

Treatment of faecal incontinence starts conservatively consisting of regulation of defecation with a fibre-enriched diet, physiotherapy of the pelvic floor and medication-inducing constipation like loperamide or cholestamine. When unsuccessful, patients with an anal sphincter defect can be offered a sphincter repair. New surgical options for patients with or without a sphincter defect are dynamic gracilis plasty [4], or sacral neuromodulation [5] or artificial bowel sphincter [6]. Yet all these treatments have success percentages defined as substantial improvement varying around 70%, carry some side effects, demand specific expertise and are not generally available.

A new emerging technique is radiofrequency (RF) energy delivery to the anorectal junction. Tissue heating with

the delivery of RF energy results in immediate collagen contraction, followed by local wound healing, remodelling and tightening [7]. It has been applied for nongastro-intestinal diseases (obstructive sleep apnoea, snoring, benign prostatic hyperplasia, joint capsule laxity) and has also been successfully used in the gastro-oesophageal junction for gastro-oesophageal reflux disease [8].

Two recent open-label trials suggested improvement in the faecal incontinence score and the quality of life [9,10], one with a follow-up of 2 [11] and 5 [12] years. The clinical results varied in these two studies. The technique is feasible as an outpatient procedure and has little side effects concerning local discomfort. Anorectal function tests suggested some changes in rectal sensitivity, but no other changes in anorectal function or ultrasound were found.

The aim of this pilot study was to treat patients with SECCA to establish the decrease of their complaints of faecal incontinence and to study possible changes in anorectal function and three-dimensional ultrasound.

Patients and methods

Patients

Patients with faecal incontinence for at least 6 months, a Vaizey incontinence score [12] of at least 12 and failure of conservative treatment, based on diet recommendations, antidiarrhoeals and physiotherapy without a significant sphincter defect suited for sphincter repair were included. Patients were excluded if they had proctitis or inflammatory bowel disease, chronic diarrhoea, chronic constipation, overflow incontinence, previous ileoanal or coloanal anastomosis, rectal prolapse, anal stenosis, anal fissures or fistulas, pelvic radiation, coagulation disorders or the use of anticoagulants. Patients with haemorrhoids or mucosal prolapse were treated first with rubber band ligation and could be included 6 weeks later.

Medical history was obtained at baseline and after 3, 6 and 12 months including Vaizey score (0 = no complaints, 24 = fully incontinent) [12], improvement (none, slightly improved and improved) and side effects.

On digital palpation sphincter pressure was scored as low, normal or high. Defects were also described and measured in hours (1–12 h, with 12 h being anterior).

All patients underwent colonoscopy in their previous work-up.

Methods

Anal manometry

Anal manometry was performed with an open-tip perfusion system using a disposable catheter with four 90° radial-orientated side ports connected to a Polygraf ID

(Medtronic, Skovlunde, Denmark). After calibration, the catheter is automatically withdrawn by a puller at a speed of 3 cm/s. The average increase in pressure to the atmosphere pressure is the maximum basal pressure. The length over which the increase is present is the sphincter length. The catheter is introduced again and manually withdrawn with steps of 0.5 cm, whereas the patient is asked to squeeze maximally. The average maximum increase in pressure above the existing basal pressure is the maximum squeeze pressure. The distension reflex was elicited by inflating the rectal balloon, and the volume was registered.

Rectal compliance measurement

A compliant balloon catheter is introduced into the rectum. Air is inflated manually with a syringe with a speed of 60 ml in 15 s to a maximum of 300 ml. The volume of first sensation, urge to defecate and maximum toleration is noted.

Three-dimensional anal ultrasound

Anal ultrasound was performed using a three-dimensional diagnostic ultrasound system (Falcon type 2101 EXL, B-K Medical, Naerum, Denmark) with a 5–16 MHz rotating endoprobe (type 2050, focal range 2–4.5 cm) with an internal puller (diameter 1.7 cm) producing a 360° view. Three-dimensional anal ultrasound was performed according to a standard procedure with an automatic puller. The endoprobe was covered with a lubricated condom, which was filled with ultrasound gel. The probe was then introduced into the rectum and a recording was made of the distal part of the rectum, the puborectalis muscle and the anal canal. After the ultrasound, images were reconstructed to three-dimensional images by computer software.

Defects External anal sphincter defects were described as hypoechoic lesions and the extent of the defect was axially measured in hours (1–12 h, with 12 h anterior, 3 h left lateral, etc.). The length of the defect was indicated as proximal, distal or total. A defect comprised at least 1 h of the circumference of the sphincteric ring. Internal anal sphincter defects were described as a disruption of the internal ring.

Atrophy Atrophy of the EAS was judged upon its reflection of the outer interface (border external anal sphincter and subadventitial fat), reflection pattern and length. Atrophy was scored as none (clearly visible outer interface, mixed reflection pattern), moderate (partly visible outer interface, intermediate reflection, moderate shortening) and severe (hardly visible outer interface, hyperechoic reflection pattern, severe shortening) [13].

SECCA procedure

Patients were treated in the outpatient department in the endoscopy unit. Prophylactic antibiotics (500 mg

metronidazole and 500 mg amoxicillin/125 mg clavulanic acid) were taken before the procedure and repeated afterwards and 8 h later. One hour before the procedure patients received a rectal enema. An intravenous catheter was placed and sedation with 0.05 mg fentanyl and 7.5 mg midazolam was administered. During the procedure more sedation could be added when necessary. Local perianal anaesthesia with 10 ml lidocaine 0.5% with epinephrine 1 : 200 000 was administered in four quadrants. A standard electrosurgical ground pad was placed on the patient's back or flank according to hospital safety standards. The RF generator was turned on, the ground pad connected to the generator, the SECCA hand piece connected to the generator, and the plastic tube and sterile water bag attached to the hand piece and the pump on the generator.

The SECCA device (Fig. 1) comprises an anoscopic barrel with four nickel–titanium curved needle electrodes deployed from within (22 gauge, 7 mm length; Curon Medical, Sun Valley, California, USA). The hand piece is positioned under direct vision at the proper position in the anal canal (Fig. 2) and the needles are deployed into the muscle (Fig. 3). Irrigation of the mucosa was begun via the coolants ports on the hand piece, and RF (465 kHz, 2–5 W) was delivered for 60 s, resulting in four thermal lesions. Target lesion temperature was 85°C. After the 60 s interval, the needles were retracted and the hand piece was repositioned. In total five levels, starting at the dentate line, going up with steps of 1 cm until 4 cm above the dental line, and four quadrants, are treated, thus 80 RF deliveries. When during the procedure displacement of the needles or drop out of the device occurred before 30 s, the procedure was repeated at the place after repositioning. If the rectovaginal septum was thin and short, less than five applications were performed

Fig. 1



SECCA hand piece (probe).

Fig. 2



Introduction of probe with mucosa visible.

anteriorly. The RF procedure took about 30 min, including preparation about 1 h.

Post-treatment care

Patients recovered in a monitored unit for 1 h or longer when necessary and were discharged subsequently. After the treatment and 8 h later the antibiotic intake was repeated. Patients were denied nonsteroidal anti-inflammatory drug use during 2 weeks; paracetamol was allowed when needed. Constipation was treated with a polyethylene glycol when necessary.

Patient follow-up was scheduled at 6 weeks, 3, 6, 9 months and 1 year.

Statistical analysis

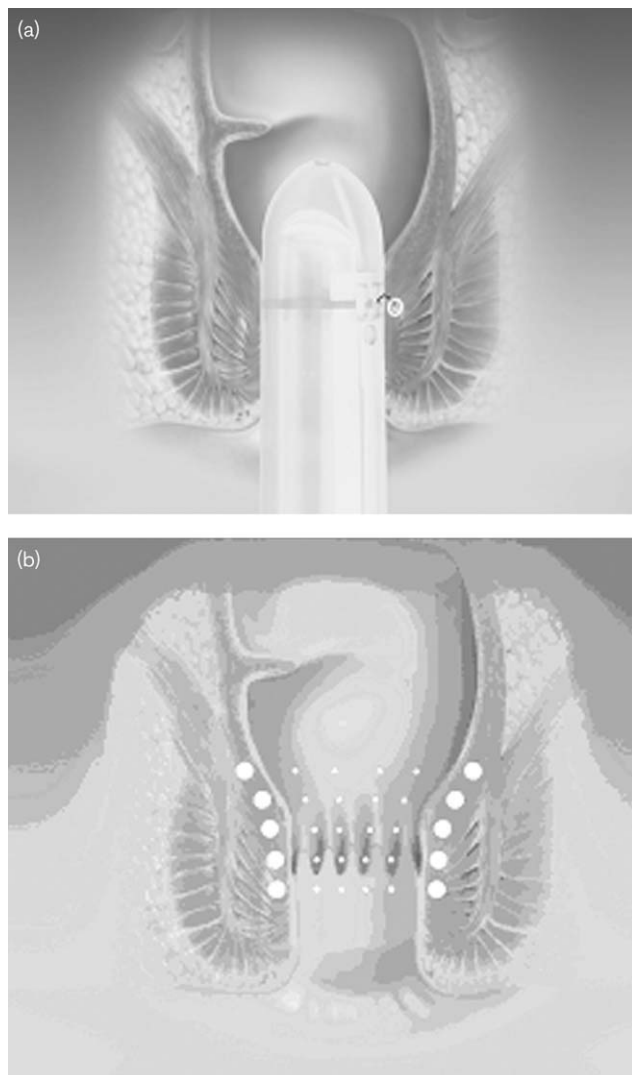
Results were described and presented as mean, median and interquartile range when suitable. Differences were calculated with the paired *t*-test.

Results

Clinical response

Eleven patients were included, all were women, mean age was 61 years (range 49–73). Their characteristics are shown in Table 1. The mean time of complaints of faecal incontinence was 12 years (range 2–38). All but one had vaginal deliveries.

Fig. 3



Schematic design of the probe in the anus (a) and after treatment (b).

Six of 11 (55%) patients stated that they had improved (one patient only slightly) (Table 2). The Vaizey scores of all patients decreased from pretreatment to 3 months from 18.8 to 15.0 ($P = 0.03$, mean decrease 3.7, SD 4.0) and of the improved from 18.3 to 11.5 ($P = 0.03$, mean improvement 6.8, SD 4.5), persisting after 6 and 12 months. There were no differences in biological characteristics between the responders and nonresponders.

The remarks of the patients were registered extensively. Those who improved were very pleased with the treatment. The most striking remarks were that four patients said that they felt urge and now had 5 min to reach the toilet instead of 1 min. No predictive factors concerning the demography of the patients and their clinical result or Vaizey score was found.

Anal manometry, rectal compliance measurement and three-dimensional anal ultrasound

Anal manometry and rectal compliance showed no significant changes after 3 months, neither in those who improved nor in those who did not. There was a tendency of decrease in urge and maximum toleration after 3 months, but this was not significant in the whole group (both $P = 0.3$) as well in the improved ($P = 0.8$ and 0.6) and those who did not ($P = 0.6$ and 0.8) (Table 3).

Anal ultrasound at pretreatment showed a small scar in the external anal sphincter in one patient. Slight atrophy was seen in all patients. Immediately after the procedure no changes were seen, except for some small fluid accumulations due to the local anaesthesia in some patients. After 3 months, no differences from pretreatment anal ultrasound were seen.

Side effects

The procedure was well tolerated and almost without discomfort. Two patients had slight and one had moderate pain during the procedure.

Table 1 Patient baseline characteristics

Age	Years with faecal incontinence	Vaginal deliveries	Anorectal trauma	Anorectal surgery	Wears pads	Stool	Stool frequency	Urinary incontinence	Other disease
Patients improved in continence									
55	30	0	–	–	Yes	Normal	1/day	No	Sjögren
60	7	3	Episiotomy	Hysterectomy	Yes	Normal	1/day	No	CVA
60	3	3	Episiotomy	–	Yes	Soft	2/day	No	Type 2 diabetes mellitus
58	3	2	–	–	Yes	Normal	2/day	Yes	Melanoma
49	5	2	Episiotomy	–	Yes	Solid	Once per 3/days	No	No
67	2	6	–	–	Yes	Normal	1/day	No	Hypertension
Patients not improved in continence									
64	38	2	–	Hysterectomy	Yes	Soft	3–4/day	Yes	Rheumatic disease
73	4	2	Straining	–	Yes	Soft/normal	0–1/day	No	Regulated thyroid dis
57	10	2	Episiotomy	–	No	Soft	2/day	No	No
60	2	2	3rd-sphincter rupture	Bladder fixation	Yes	Hard	Once per 3/days	Yes	Haemochromatosis
60	10	2	–	–	Yes	Soft	2/day	No	Hypertension

CVA, cerebrovascular accident; dis, disease.

There were no major side effects. No hospital admissions or outpatient clinic visits were needed. Eight patients (73%) had a slightly painful anus during the first 1–3 days, two patients had moderate pain and one patient had severe pain during 1 week. Five patients (45%) had haematoma and/or minor bleeding during 2–7 days. Three patients (27%) had antibiotic-associated diarrhoea and one had subsequently transient worsening of the faecal incontinence.

Discussion

This prospective study has demonstrated that RF energy application has a significant therapeutic effect in some patients on the symptoms of faecal incontinence.

The results of our study are comparable with those described by Efron *et al.* [10] in a multicentre study in 50 patients (43 women) after 6 months. We had a clinical

response of 55% compared with 60% in Efron *et al.*'s study. The faecal incontinence scores were also quite similar. Although we used the Vaizey score and Efron *et al.* the Cleveland Clinic Incontinence score, patients improved in these scores by 13 and 17%, respectively.

The initial study of Takahashi *et al.* [9] from 2002 in 10 women showed better results after 2 years [11] persisting after 5 years [12]. Here 80% of the patients improved and the Wexner score improved from 13.5 to 5 (43%).

In our patients the result was reached after 3 months and remained stable throughout the year. In Efron *et al.*'s study, there was an additional improvement of three patients (6%) after 6 months.

Takahashi *et al.*'s patients remained stable; after 5 years their situation was comparable with 3 months [unpublished data]. No further improvement in Takahashi *et al.*'s study was seen between 6 and 12 months. Therefore, basically the improvement can be judged after 3 months.

We did not obtain a faecal incontinence quality of life score in our patients or social function questionnaire (SF-36). As the exact mechanism of improvement is not known, we interviewed our patients extensively. A very interesting and striking remark was that four patients were very pleased that they were able to retain their faeces for a longer time. This earlier sensation of an impending bowel movement permits the patient to reach the toilet in time, thus making the difference between incontinence and continence. This improvement, however, did not translate into an improved Vaizey score, because an improvement up to 15 min is required for a

Table 2 Vaizey incontinence score in time

Patient	Vaizey 0	Vaizey 3 months	Vaizey 6 months	Vaizey 12 months	
1	19	11	11	11	Improved
2	19	12	12	12	Improved
3	22	22	22	22	No
4	19	19	19	19	No
5	21	10	10	10	Improved
6	17	14	14	14	Improved
7	19	19	19	19	No
8	15	9	9	9	Improved
9	19	13	13	13	Slightly improved
10	18	18	18	18	No
11	19	19	19	19	No
Mean	19	15	15	15	
SD	2	4	4	4	

Table 3 Anorectal function tests (anal manometry and rectal compliance) at baseline and after 3 months

		Anal manometry						Rectal compliance					
MBP 0	MBP 3	MSP 0	MSP 3	SL 0	SL 3	DRvol 0	DRvol 3	FS 0	FS 3	Urge 0	Urge 3	MTV 0	MTV 3
Patients improved in continence													
45	55	75	60	3	4	20	10	15	40	210	130	240	200
20	10	30	30	3	X	10	20	145	100	270	190	320	240
70	40	30	30	4.5	4.5	20	50	55	40	80	150	125	200
20	20	10	10	3	3	40	20	20	45	100	80	165	100
40	40	20	40	4	4	20	20	75	15	250	180	315	210
20	20	25	30			10	20	70	180	90	200	145	240
Mean (SD)													
36 (20)	31 (17)	32 (23)	34 (16)	3.5 (0.7)	3.9 (0.6)	20 (11)	23 (14)	63 (47)	70 (61)	167 (86) [^]	155 (45) [^]	218 (86) [']	198 (51) [']
Patients not improved in continence													
30		20		3		20							
50	55	40	50	3.5		30	30	120	70	150	100	240	200
40	40	20	20	4	4	10	20	15	15	50	35	80	70
30	20	15	15	3	3.5	20	40	155	145	210	200	240	245
30	20	10	30	3.5		30	30	70	100	140	110	250	240
Mean (SD)													
36 (9)	34 (17)	21 (11)	29 (15)	3.4 (0.4)	3.8 (0.4)	22 (8)	30 (8)	90 (61)	83 (55)	138 (66) ^{^^}	111 (68) ^{^^}	203 (82) ^{''}	189 (82) ^{''}
All patients mean (SD)													
36 (15)	32 (16)	27 (18)	32 (15)	3 (0.5)	4 (0.5)	21 (9)	26 (12)	74 (52)	75 (56)	155 (76) [#]	138 (56) [#]	212 (80) [*]	195 (61) [*]

MBP, maximum basal pressure (mmHg); MSP, maximum squeeze pressure (mmHg); SL, sphincter length (cm); DRvol, volume to evoke distension reflex; FS, first sensation (ml); Urge, urge to defecate (ml); MTV, maximum toleration (ml); 0, before treatment; 3, results after 3 months.
[^]P=0.8, [']P=0.6, ^{^^}P=0.6, ^{''}P=0.8, [#]P=0.3, ^{*}P=0.3.

change on this scale. This underlines the importance of not only questionnaires, but also the remarks of the patients. For future studies it seems wise to consider both questionnaires and remarks of the patients, because the latter are not always caught in a questionnaire.

We experienced no major side effects. Efron *et al.* [10] had initially some serious side effects with two severe ulcerations in two patients, leading in one patient to worsening of the complaints. These adverse events were procedure-related leading to a change in the protocol by increased mucosal cooling. The third patient had a bleeding 30 days after the procedure from a haemorrhoidal vein requiring suture ligation. Takahashi *et al.* [9] also reported one serious bleeding requiring ligation.

All our patients had some local anal pain in the first days; 73% resolved within 1–3 days. Only one patient had severe pain during the first week. Efron *et al.* [10] reported severe pain in 10%. Self-limiting bleeding was seen in 45%, Efron *et al.* [10] reported five (10%) minor bleeding and Takahashi *et al.* [9] three (30%). In three (27%) patients we observed diarrhoea associated with antibiotics and Efron *et al.* [10] in six patients (12%). Efron *et al.*, also encountered fever in two patients without signs of local infection. Takahashi *et al.* [9] reported a smaller first rectal sensation and rectal volume. Efron *et al.* [10] could not confirm this in their patients, but in a subgroup analyses from their own clinic there was a decrease in first rectal sensation. We could not confirm this, there was a tendency towards a decreased urge and maximum-tolerated volume. Four patients indicated clearly that they felt urge earlier, for example before it had passed the anus. Considering the working mechanism, fibrosis and contraction in the sphincter it seems logical that, if any changes were found, it had to be sensation because of a smaller distal rectal volume. In addition, our measurement tools are probably not very sophisticated to reveal small changes in anorectal function [14].

Changes in anal pressure were not found. Other treatments for faecal incontinence, like sphincteroplasty [15,16] or sacral neuromodulation [17,18] have not always demonstrated increased anal pressures in those who improved.

Anal ultrasound could not reveal any changes. In several patients temporary fluid collections were seen because of the local anaesthesia, but no structural changes were found after 3 months.

Although not all patients improve and some of those who improve are not totally symptom free, the treatment carries little side effects and is easy to perform on an outpatient basis. In addition, it does not preclude patients

from undergoing other procedures such as graciloplasty, sacral neuromodulation or artificial bowel sphincter. These surgical procedures however are not without complications and again success lies around 70%. Therefore, the SECCA procedure merits more attention and warrants a randomized controlled trial, which is currently underway.

Conclusion

The SECCA procedure seems a feasible, safe outpatient procedure with a moderate clinical effect in patients in whom diet regulation and physiotherapy have failed and sphincteroplasty is not indicated. The working mechanism is probably increase in local sensation, thus permitting the patient more time to reach the toilet. A randomized controlled trial seems warranted.

References

- Rao SS. Pathophysiology of adult faecal incontinence. *Gastroenterology* 2004; **126** (Suppl 1):S14–S22.
- Sultan AH, Kamm MA, Hudson CN. Pudendal nerve damage during labour: prospective study before and after childbirth. *Br J Obstet Gynaecol* 1994; **101**:22–28.
- Melville JL, Fan MY, Newton K, Fenner D. Fecal incontinence in US women: a population-based study. *Am J Obstet Gynecol* 2005; **193**:2071–2076.
- Chapman AE, Geerdes B, Hewett P, Young J, Evers T, Kiroff G, Maddern GJ. Systematic review of dynamic graciloplasty in the treatment of faecal incontinence. *Br J Surg* 2002; **89**:138–153.
- Kapoor DS, Thakar R, Sultan AH. Combined urinary and faecal incontinence. *Int Urogynecol J Pelvic Floor Dysfunct* 2005; **16**:321–328.
- Belyaev O, Muller C, Uhl W. Neosphincter surgery for fecal incontinence: a critical and unbiased review of the relevant literature. *Surg Today* 2006; **3**:295–303.
- Gustavson KH. *The chemistry and reactivity of collagen*. New York: Academic Press; 1956.
- Yeh RW, Triadafilopoulos G. Endoscopic antireflux therapy: the Stretta procedure. *Thorac Surg Clin* 2005; **15**:395–403.
- Takahashi T, Garcia-Osogobio S, Valdovinos MA, Mass W, Jimenez R, Jauregui LA, *et al.* The radio-frequency energy delivery to the anal canal for the treatment of fecal incontinence. *Dis Colon Rectum* 2002; **45**:915–922.
- Efron JE, Corman ML, Fleshman J, Barnett J, Nagle D, Birnbaum E, *et al.* Safety and effectiveness of temperature-controlled radio-frequency energy delivery to the anal canal (SECCA procedure) for the treatment of fecal incontinence. *Dis Colon Rectum* 2003; **46**:1606–1616.
- Takahashi T, Garcia-Osogobio S, Valdovinos MA, Belmonte C, Barreto C, Velasco L. Extended two-year results of radio-frequency energy delivery for the treatment of fecal incontinence (the SECCA procedure). *Dis Colon Rectum* 2003; **46**:711–715.
- Vaizey CJ, Carapeti E, Cahill JA, Kamm MA. Prospective comparison of faecal incontinence grading systems. *Gut* 1999; **44**:77–80.
- Cazemier M, Terra PT, Stoker J, Lange de-Klerk ESM, Boeckstaens GEE, Felt-Bersma RJF. Atrophy detection of the external anal sphincter: comparison between three-dimensional anal endosonography and endoanal MRI. *Dis Colon Rectum* 2006; **49**:20–27.
- Sloots CE, Felt-Bersma RJ, Cuesta MA, Meuwissen SG. Rectal visceral sensitivity in healthy volunteers: influences of gender, age and methods. *Neurogastroenterol Motil* 2000; **12**:361–368.
- Felt-Bersma RJ, Cuesta MA, Koorevaar M. Anal sphincter repair improves anorectal function and endosonographic image. A prospective clinical study. *Dis Colon Rectum* 1996; **39**:878–885.
- Gearhart S, Hull T, Floruta C, Schroeder T, Hammel J. Anal manometric parameters: predictors of outcome following anal sphincter repair? *J Gastrointest Surg* 2005; **9**:115–120.
- Uludag O, Koch SM, van Gemert WG, Dejong CH, Baeten CG. Sacral neuromodulation in patients with fecal incontinence: a single-center study. *Dis Colon Rectum* 2004; **47**:1350–1357.
- Michelsen HB, Buntzen S, Krogh K, Laurberg S. Rectal volume tolerability and anal pressures in patients with fecal incontinence treated with sacral nerve stimulation. *Dis Colon Rectum* 2006; **49**:1039–1044.