

## Rectal Hyposensitivity and Altered Anorectal Tone, Capacity and Motor Function in Faecal Incontinence after Surgery for Anal Fissure and Rectal Prolapse

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### Abstract

**Aim:** To investigate the rectal and anal sphincter factors that might contribute to the development of fecal incontinence (FI) after anal fissure and rectal prolapse surgery.

**Methods:** Fourteen patients with FI after sphincterotomy (n = 8) and rectal prolapse surgery (n = 6) were studied [clinical assessment, rectosigmoidoscopy, anorectal manometry, including rectoanal inhibitory reflex (RAIR) measurement, and barostat (rectal sensitivity, tone, compliance and capacity) and compared with 10 asymptomatic healthy subjects (HS). The time after surgery was over 22 months. The continence score was after sphincterotomy  $12.8 \pm 1$  and after rectal prolapse surgery  $14.4 \pm 2$  (St Mark's FI grading system).

**Results:** Compared with HS, rectal tone was increased in patients who had undergone sphincterotomy ( $p = 0.042$ ), and rectal capacity lessened after rectal prolapsed procedures ( $p = 0.037$ ). All patients at similar pressures as HS reported a noxious stimulus of pain. In sphincterotomy patients, the thresholds for non-noxious stimuli of the sensations of gas ( $p = 0.016$ ) and urge to-defecate ( $p = 0.043$ ) were reported at higher pressures compared with HS. Patients with sphincterotomy showed greater anal resting pressures ( $p = 0.014$ ), greater anal squeeze pressure ( $p = 0.004$ ) and a higher amplitude of relaxation in their RAIR ( $p = 0.0006$ ) than HS. Patients with rectal prolapse surgery showed lesser percentages of relaxation ( $p = 0.029$ ).

**Conclusion:** Anorectal surgical procedures alter continence mechanisms in diverse ways. Patients with sphincterotomy present motor alterations, impaired rectal tone and rectal hyposensitivity for non-noxious stimuli. Patients after rectal prolapse surgery present altered rectal capacity and RAIR with lesser percentage of relaxation. The results also suggest that impaired afferent nerve pathways and abnormal rectal structures and functions are involved in the pathogenesis of FI after anal fissure and rectal prolapse surgery.

**Keywords:** Faecal Incontinence; Anorectal Surgery; Visceral Sensitivity; Barostat; Anorectal Manometry; Sphincterotomy; Anal Fissure; Rectal Prolapse

### Introduction

Fecal incontinence (FI) described as the recurrent uncontrolled passage of fecal material for at least 3 months [1], is a serious problem that even presents sex differences in its clinical and physiological characteristics [2]. In the general population, its prevalence varies from 7 to 15 %, up to 30 % in hospitals and up to 70 % in long-term care settings [3]. Its etiology varies. FI following anorectal surgery is

significant [4]. In a reported sample of 1074 patients who underwent anorectal procedures the overall postoperative FI rate was 18.7%. The incontinence rate was 41.8% after fistula procedures, 12.4% after hemorrhoid procedures and 9.2% after fissure procedures [5]. Anal fissure (fissure-in-ano) is a very common anorectal complaint [6] and FI is a well-documented early and late complication of anal fissure surgery [7]. It is reported in a systematic review and meta-analysis that the long-term (2 years or more) risk of continence disturbance after lateral internal sphincterotomy is noteworthy [8]. Situation that lead to a negative impact on the quality of life [9]. Rectal prolapse, the protrusion of the layers of the rectal wall through the anal canal, may be partial (mucosal) or complete (full thickness) [10]. Internal rectal prolapse is recognized as an etiological factor in FI and despite adequate anatomical repair, FI persists in a number of patients [11]. Although no exact mechanism has been elucidated, FI develops along with alterations in rectal neuromuscular dysfunction and abnormalities in rectal sensory and motor function [12]. In this context, it has been informed that rectal tone and compliance are impaired in patients with FI after fistulotomy [13], and that rectal distensibility and the volume thresholds for sensations decrease after stapled haemorrhoidopexy [14]. These few physiological data and the insufficient knowledge of the true participation of the rectum, the anal sphincters and the neurotransmission involved highlight the need to investigate from a new approach FI after anorectal surgery. Assess the visceral afferent sensation using an electronic barostat [13,15] and motor function through anorectal manometry [13,16-18] may clarify this subject. This work aimed to identify the rectal and anal sphincter factors that might contribute to the development of FI after anal fissure and rectal prolapse surgery.

### Materials and Methods

#### Subjects

The study was carried out at the Experimental Medicine and Motility Unit in the Gastroenterology Service of Mexico City General Hospital. The Ethical and Research Committee accepted the protocol, and signed informed consent was obtained from all subjects and treating physicians. The study was performed in agreement with the Declaration of Helsinki and its following revisions. The data of all enlisted consecutive outpatients presenting with FI after anorectal surgery during a 12-month period at our motility-based problems tertiary unit were entered into a database for further analysis. Inclusion criteria were age over 18 years, FI for a minimum of 6 months after anorectal surgery, and consent for the study. Exclusion criteria included previous anorectal and non-anorectal surgery, idiopathic or postpartum FI, pelvic radiation, a state of pregnancy or nursing, any concomitant disease, and psychiatric alterations. Fourteen patients were enrolled into the study. Eight patients suffered from anal fissure ( $43.8 \pm 12$  years, 5 females) and six from rectal prolapse ( $60 \pm 13$  years, 4 females). The clinical data were observed in patients before surgery. Two patients presented with constipation and only one patient who suffered from rectal prolapse presented FI to gas before anorectal surgery. The laboratory test parameters as performed on all patients were normal. The severity of FI after anorectal surgery was graded using the St Mark's faecal incontinence grading system (Table 1) [19,20]. A historical control group previously described was utilized [13]. All subject controls were healthy subjects (HS) who agreed to participate in the study. None of the controls were proctologic patients of any type. All subjects underwent an evaluation of their clinical history, blood count with chemistry panel, three coproparasitoscopic studies, wet mount preparations for amoeba assessment, rectosigmoidoscopy (Welch Allyn 32823 sigmoidoscope, Skaneateles Falls, NY, USA), anorectal manometry (MMS, AN Enschede, The Netherlands) and barostat rectal sensitivity studies (Distender II; G. & J. Electronics, Toronto, Canada).

#### Study and Distension Protocol

The procedure that we use habitually in our laboratory to assess visceral sensation has already been published in detail elsewhere [15]. In brief, we have reported [15] that rectal visceral sensitivity is evaluated with an electronic barostat that is a tool that keeps a constant pressure in an air-filled bag through a feedback mechanism. This cylindrical ultra-thin polyethylene bag (Mui Scientific, Ontario, Canada) has infinite compliance and reaches 600 mL. The individual operating pressure (IOP) is defined as the minimum pressure required to overcome passive resistance to bag inflation [21]. To obtain muscle tone, the bag is inflated to the IOP, and the volume recorded over a 15-min period. We [13,15,22,23] and others investigators [21,24] have also reported that the barostat using the ascending method

of limits procedure performs rectal distension for one minute, with increase of 4 mmHg each time and separated by periods of a minute, in which the bag pressure returns to the IOP. The distensions continue until the subject reports pain, press the panic button or reach a pressure of 48 mmHg.

**Statistical Analysis**

The outcome measures were the anorectal manometry and barostat results in patients with FI after anal fissure and rectal prolapse surgery compared with that of HS. A 95% CI was analyzed for all of the variables and used when was appropriate. The results are expressed as means ± SD. P < 0.05 and Student’s two tailed t tests were utilized. The statistical analyses were performed using 2000 Graph-Pad Software (San Diego, CA, United States).

**Results**

**Subjects**

Fourteen patients with FI after sphincterotomy (n = 8, 43.8 ± 12 years, 5 females) and rectal prolapse surgery (n = 6, 60 ± 13 years, 4 females) were enrolled into the study and compared with asymptomatic HS. The body mass index was similar in patients with sphincterotomy (28.2 ± 3 kg/m<sup>2</sup>) and rectal prolapse (27.4 ± 6 kg/m<sup>2</sup>) compared with HS (26 ± 5 kg/m<sup>2</sup>, p = 0.3) in the barostat group. The average time after surgery was over 22 months. All patients suffered faecal incontinence: (sphincterotomy 6.7 ± 9.6 incontinence episodes per week; 95% CI -0.41 to 13.8) and rectal prolapse 10.3 ± 6 incontinence episodes per week; 95% CI 3 to 17.5. The continence score was after sphincterotomy 12.8 ± 1 (95% CI 11.9 to 13.7) and after rectal prolapse surgery 14.4 ± 2 (95% CI 12.3 to 16.4), based on the St Mark’s faecal incontinence grading system: minimum score = 0 = perfect continence, maximum score = 24 = totally incontinent (Table 1). The laboratory test parameters and recto-sigmoidoscopy carried out on all patients were normal.

	Never	Rarely	Sometimes	Weekly	Daily
Incontinence for solid stool	0	1	2	3	4
Incontinence for liquid stool	0	1	2	3	4
Incontinence for gas	0	1	2	3	4
Alteration in lifestyle	0	1	2	3	4
				No	Yes
Need to wear a pad or plug				0	2
Taking constipating medicines				0	2
Lack of ability to defer defecation for 15 minutes				0	4

**Table 1:** St Mark’s faecal incontinence grading system [19,52].

*Never, no episodes in the past four weeks; rarely, 1 episode in the past four weeks; sometimes, > 1 episode in the past four weeks but < 1 a week; weekly, 1 or more episodes a week but < 1 a day; daily, 1 or more episodes a day. Add the scores from each row; minimum score = 0 = perfect continence; maximum score = 24 = totally incontinent.*

**Rectal tone, compliance and capacity**

IOP was similar and not significant in FI patients after sphincterotomy (8.4 ± 1 mm Hg; 95% CI 7 to 9; p = 0.19) and rectal prolapse surgery (7.9 ± 0.1 mm Hg, 95% CI 7.8 to 8; p = 0.07) compared with HS (9.6 ± 2 mm Hg; 95% CI 8 to 10).

**Rectal tone:** Rectal bag volume (low bag volume indicates increased smooth muscle tone in the rectum) was lesser in patients who had undergone sphincterotomy ( $p = 0.042$ ) compared with HS (Table 2). Patients with rectal prolapse showed no differences from HS ( $p = 0.069$ ).

Barostat data	Sphincterotomy (n = 8)	Rectal prolapse (n = 6)	Healthy subjects (n = 10)
Tone (bag volume, ml)	50.7 (16.3 - 85)*	53.2 (15.8 - 90.5)	103.5 (71.8 - 135)
Compliance (v/p)	6.2 (1.8 - 10.7)	6.7 (1.9 - 11.4)	11.7 (7.4 - 16)
Rectal capacity (ml)	342.6 (304 - 380.7)+	207 (145.6 - 268.9)*	302.8 (251.8 - 353.9)
First sensation (mmHg)	18.4 (15.8 - 20.9)	15.4 (11.7 - 19)	14 (10.9 - 17)
Gas sensation (mmHg)	24.9 (21.7 - 28.2)*	21.3 (14 - 28.4)	17.9 (14 - 21.6)
Urge defecate (mmHg)	31.3 (24.4 - 38)*	24 (12 - 35.9)	22.4 (17.9 - 26.9)
Pain sensation (mmHg)	35.8 (32.4 - 39.2)	26.3 (15.7 - 36.9)	35.9 (30.4 - 41.3)
Anorectal manometry			
Anal resting pressure (mmHg)	62 (48.8 - 75.3)*+	22 (7.4 - 38.1)	34 (21.3 - 48.4)
Anal squeeze pressure (mmHg)	113 (67.5 - 158.4)*	66 (24.6 - 108.3)	43 (28.4 - 57.9)
RAIR frequency (#)	1.38±1.6 (0.2 - 2.5)	0.17±0.4 (- 0.1 - 0.4)	1.36±1.6 (0.4 - 2.3)
RAIR amplitude (mmHg)	48±16 (36 - 59)*+	14.4±12.4 (4.4 - 24.4)	22±10 (15.9 - 28)
RAIR relaxation (%)	63 (54.4 - 72.2)+	41 (30 - 52.5)	74 (55.7 - 93)
RAIR duration (s)	24 (20.8 - 27.4)+	14 (7.6 - 21.7)	19 (16.3 - 23.3)

**Table 2:** Physiological data.

All data represent the mean (95% CI). RAIR=Rectoanal Inhibitory reflex

Comparison with healthy subjects. \* $p < 0.05$

Comparison with rectal prolapse patients. + $p < 0.05$

**Rectal Compliance:** Anorectal surgical procedures showed no differences in rectal compliance (ml per mmHg) compared with HS.

**Rectal Capacity:** Rectal capacity (balloon volume at the maximum imposed pressure) [25] was lesser in patients with rectal prolapse compared with HS ( $p = 0.037$ ; Table 2) or with sphincterotomy ( $p = 0.002$ ). Patients with sphincterotomy showed no differences in rectal capacity compared with HS.

### Sensory thresholds to rectal distension

Table 2 shows that patients with sphincterotomy, or rectal prolapse surgery reported their first sensations and noxious stimulus of pain at levels that were not significantly different from HS.

On the other hand, sphincterotomy patients demonstrated higher thresholds for non-noxious stimuli in fasting gas ( $p = 0.016$ ) and urge-to-defecate ( $p = 0.043$ ) sensations than HS.

### Anorectal Manometry

Patients who underwent sphincterotomy showed greater anal resting pressure ( $p = 0.014$ ) and greater anal squeeze pressure ( $p = 0.004$ ) compared with HS. On the other hand, patients who underwent rectal prolapse surgery ( $p = 0.29$ ) showed no significant differ-

ences from HS (Table 2). The rectoanal inhibitory reflex (RAIR) frequencies were similar in all groups. However, the amplitude of RAIR relaxation was higher in patients with sphincterotomy compared with HS (Table 2;  $p = 0.0006$ ). Patients with sphincterotomy ( $p = 0.0014$ ) showed higher RAIR amplitudes than rectal prolapse patients. Patients with sphincterotomy also showed greater RAIR percentages of relaxation ( $p = 0.010$ ) and duration ( $p = 0.024$ ) than patients who were treated for rectal prolapse.

## Discussion

The interesting and new findings of the present study are that FI after anorectal surgery may appear independently of a subjacent disease or the surgical procedure performed.

The involvement of anal sphincters in FI is uncertain. It was informed that one-third of the subjects who suffer from FI do not have any anal dysfunction [26] data supported by Burgell, *et al.* [27] who reported that among 160 male patients with FI only one-third of them demonstrated sphincter dysfunction. Besides, it is reported that internal rectal prolapse is common in females with urge faecal incontinence, without anal sphincter lesions [28]. In contrast, a recent review of 162 patients with FI revealed that 74% of the patients had sphincter dysfunction on anorectal manometry [29]. In the present study, only patients with sphincterotomy showed anorectal manometric alterations characterised by increased anal resting and squeeze pressures, as well as greater amplitudes of the RAIR. This is not surprising given that patients with chronic anal fissures before sphincterotomy present hypertonia of the internal anal sphincter [30]. And even six months after surgery resting pressure is reported higher with respect to HS [30]. In addition, a morphometric data of the anal canal at 3.0 Tesla MR imaging shows that patients with chronic anal fissure had longer anal canal and thicker internal anal sphincter muscle at mid-anal level [31]. Our data disagree with Bharucha, *et al.* [32] who report lower anal squeeze pressures in women with idiopathic FI. The aetiology of this incontinence may explain this discrepancy; the fact that we have men and women in our group may be significant, as squeeze pressure has been reported to be higher on average in men with FI than in women [2]. On the other hand, our data partially agree with Lindsey *et al.*, who report that the maximum squeeze pressure was normal in 52% of 93 patients with FI after anal surgery [33].

The rectoanal inhibitory reflex (RAIR) [18] is a very important anorectal reflex that reflects the integrity of mechanisms of the anorectal physiology and is correlated with anorectal symptoms of FI [34]. In the current study, patients with FI after sphincterotomy showed a higher amplitude of relaxation in their RAIR ( $p = 0.0006$ ) and patients with FI after rectal prolapse surgery showed lesser percentages of relaxation ( $p = 0.029$ ) in their RAIR than HS. These data agree with a study that reported differences in RAIR parameters between incontinent and normal cohorts [35], as well as with another studies that reported a reduced frequency of RAIR in patients with idiopathic FI [36] and an absent RAIR in systemic sclerosis patients with FI; which suggests neuropathy [37]. Regarding increased RAIR amplitudes of inhibition, we only found one report from our laboratory that showed a postprandial increase of RAIR amplitude in patients with irritable bowel syndrome and constipation [18]. On the contrary, the presence in spinal cord injury patients of a greater RAIR amplitude reduction seems to be a factor in FI [38]. It is therefore necessary to recognise other potential participants in the continence mechanism, among which could be the rectum.

In the present study, sphincterotomy patients showed higher rectal tone than HS. A high colonic tone was also observed after left colonic surgery, which agrees in part with our data [39]. However, our data disagree with Worsoe, *et al.* [36] who report that in patients with idiopathic FI, the rectal tone during fasting is similar to that of HS. Differences in the methodology and aetiology of incontinence may account for this discrepancy, as we utilised a barostat technique, while they used rectal impedance planimetry.

Compared with HS, sphincterotomy and rectal prolapse surgery patients showed similar rectal compliance (distensibility). In contrast, fistulotomy patients showed lower rectal compliance [13] and it is reported that rectal distensibility decreases after haemorrhoidopexy [40]. As faecal continence involves the relaxation of the rectal wall, a rectal reservoir of adequate capacity and effective voluntary anal sphincter function [41], rectal wall stiffness after surgery may explain the alteration of the tone and rectal distensibility. Related to this fact is a report that increased rectal wall stiffness after radiotherapy alters the rectal distensibility, most likely by fibrosis [42]. Further-

more, patients with FI and defects of the sphincter have been reported to have a reduced rectal capacity [43]. We agree in part with this finding, as our patients with rectal prolapse presented a reduced rectal capacity after anorectal surgery than HS; however, sphincterotomy and fistulotomy patients [13] present with rectal capacities similar to those of HS. Thus, not all patients present reduced rectal capacity after surgery. Our data are supported by a report showing that in women with idiopathic FI, rectal capacity is reduced only in 25% of cases [44]. Interestingly, it seems that most prolapse patients present before surgery a pan-colonic motility disorder [45]. And it is recently reported that rectal prolapse traumatizes the rectum causing neural and motor defects in the wall of the rectum [46].

The thresholds for the non-noxious stimuli of gas and urge-to-defecate sensations were higher in sphincterotomy patients than in HS. These parameters describe rectal hyposensitivity as a diminished perception of rectal distension [47]. Our results agree with Burgell, *et al.* who report that one-sixth of incontinent men have rectal hyposensitivity [27]. However, our data disagree with Bharucha, *et al.* [44] who report rectal hypersensitivity in women with idiopathic FI based on a lower pressure threshold for the desire to defecate. Our results also differ from those of Chan, *et al.* [48] who report that approximately 50 percent of patients with urge FI demonstrate lowered rectal sensory threshold volumes (rectal hypersensitivity) upon balloon distension. The aetiology of incontinence through differences in methodology may account for this discrepancy, as we utilised a barostat technique while others generally used an elevated sensory threshold volume during balloon distension in clinical practice. On the other hand, as our FI after surgery patients showed different rectal tone, and capacity than HS, rectal hyposensitivity may not only reflect an impaired afferent nerve pathway but also the presence of abnormal rectal wall properties [47]. Therefore, our data suggest that rectal hyposensitivity may be a characteristic of patients who have undergone sphincterotomy. On the other hand, the noxious stimulus of pain sensation exhibited no difference between FI after surgery and HS. Our results agree in part with Salvioli, *et al.* who report that perception of rectal distension is not always reduced in FI [49]. This finding supports the concept that noxious and non-noxious distensions stimulate different afferent nerve pathways [50].

We are aware [23] that the power of this study is limited by the small number of subjects and that a small study is particularly susceptible to a type-II error; however, in such cases, power is correctly indicated by confidence intervals [51], which we used in the present study. An additional limitation could be that we did not make sensitivity procedures before surgery. However, as in other studies [13], a comparison of the data we used against HS constitutes a more reliable assessment of physiological and structural changes.

In summary, the interesting and new findings of the present study include that FI may appear independently of the subjacent disease and of the surgical procedure performed. Additionally, different anorectal surgical procedures alter continence mechanisms in different ways. According to the present data, it seems that both the rectum and the anal sphincters are involved in the pathogenesis of FI after surgery, as patients present motor alterations as well as impaired rectal tone, capacity and rectal hyposensitivity for non-noxious stimuli. The results also support the concept that noxious and non-noxious distensions stimulate different afferent nerve pathways and suggest that impaired afferent nerve pathways and abnormal rectal structures and functions are involved in the pathogenesis of FI after anal fissure and rectal prolapse surgery. Clinically, the analysis of these findings recommends having in-depth knowledge of nerve pathways and anorectal anatomy to decrease post-surgery damage. In addition, neuromodulation of the tone, rectal capacity and alteration of the visceral sensitivity can result in an innovative treatment with important clinical application.

### Disclosures

Funding None.

### Conflicts of Interest

We declare that we have no conflicts of interest.

## **Patient Consent**

Obtained.

## **Ethics Approval**

The Ethical and Research Committee of Mexico City General Hospital approved the protocol, and signed informed consent was obtained from all subjects and treating physicians.

## **Contributors**

RAA was involved in creating the protocol, evaluating the data, recruiting the patients, acquiring the results, performing the statistical analysis, and drafting of the manuscript. SC was involved in recruiting the patients, acquiring the results, and performing the statistical analysis. MG, FF and EA were involved in the recruitment of patients and the acquisition of results. All authors have seen and approved the final version of the report.

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