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Conventional cutting vs. internal anal sphincter-preserving seton for high trans-sphincteric fistula: a prospective randomized manometric and clinical trial

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Abstract Background Cutting setons have been used in complicated perirectal sepsis with good effect, although there is a moderately high incidence of fecal leakage after their use. The aim of this study was to compare a modified cutting seton, which repaired the internal anal sphincter muscle and re-routed the seton through the intersphincteric space, with a conventional cutting seton. **Methods** A total of 34 patients were randomized between 1998 and 2002. They were prospectively assessed by continence score and anorectal manometry, and for anal function, clinical sepsis and fistula recurrence. **Results** There was no difference in postoperative continence score, incidence of recurrent fistula or healing time between groups after a mean follow-up of 12 months. Resting anal manometric pressures and vector volumes were consistently higher with the modified seton (although not statistically significant), as was the area under the inhibitory curve during elicitation of the rectoanal inhibitory reflex across the full sphincter length. ($p < 0.05$).

Conclusion A larger prospective study of internal anal sphincter-preserving seton use in cryptogenic high trans-sphincteric fistula-in-ano appears justified.

Key words Cryptogenic fistula-in-ano • Internal anal sphincter • Cutting seton • Anal manometry

Introduction

One of the traditional managements of high trans-sphincteric fistula-in-ano, where the fistula tract passes through more than half of the external and internal anal sphincter musculature, has been the use of the cutting seton [1]. The advantages of such a technique include its ability to drain the region with the prevention of recurrent abscesses, the promotion of fibrosis around the seton (which in theory will prevent retraction of the continence musculature behind its advancement) and the capacity to serve as a landmark for the fistula during delayed fistulotomy or fistulectomy.

Despite acceptable rates of fistula recurrence ranging from 0% to 22% [2, 3], continence may be significantly affected following the use of a cutting seton in up to 60% of cases [4]. Lunniss et al. [5] reported that nearly half the patients reported a continence deficit after fistula surgery for trans-sphincteric tracks (where the intersphincteric space was deliberately laid open and where the internal anal sphincter (IAS) only was divided with relative preservation of the external anal sphincter; EAS). This finding suggests a significant role for the IAS in continence preservation in patients with perirectal sepsis treated by the seton technique [6].

Several techniques have been described to eradicate cryptoglandular infection while avoiding preliminary IAS sphincterotomy at the site of the internal fistulous opening. These procedures have included IAS preservation without drainage of the intersphincteric space [7], closure of the internal opening from within the intersphincteric space

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with primary track excision and EAS repair [8], rerouting of the fistula track through the intersphincteric space [9], and mucosal advancement anoplasty [10]. We performed a small, prospective randomized trial to compare conventional cutting nylon seton with an IAS-preserving cutting seton for patients with cryptogenic high trans-sphincteric fistula-in-ano.

Patients and methods

Between January 1998 and May 2002, 34 patients (25 men) with cryptogenic high trans-sphincteric fistulas were prospectively randomized into the study. Patients were assigned to each arm of the study using random numbers. Comparisons were made with a group of 33 age-matched normal volunteers (28 men; mean age, 38.9 years; range, 29–68 years) without any symptoms or signs of anorectal disease. The study was approved by the local hospital ethics committee and all subjects provided informed consent for inclusion.

All fistulas were initially assessed under general anesthesia and recorded as high, as defined by McCourtney and Finlay [7], if the internal opening was identified as being through the upper half of the anal sphincter mechanism. All fistulas were biopsied. Patients with perianal Crohn's disease or anorectovaginal fistulas were excluded from the trial. Outcome was assessed in terms of fistula eradication. Recurrence was defined in the follow-up period as perirectal sepsis or discharge occurring either at the same location as the original fistula or in a new perianal locale. Continence was assessed pre- and postoperatively using Pescatori et al.'s continence scale [11].

Anal manometry

Pre- and postoperative anal manometry was performed using an 8-channel water-perfused, flexible manometric probe, 5.5 mm in external diameter (Armdorfer, Greenvale, USA) with spirally located perfusion ports for simultaneous balloon inflation and pressure measurement. A computerized system (Polygram Lower GI Edition 6.31C3, Medtronic, London, UK) was used for data acquisition, providing graphic vector volume pressure profiles as previously reported by our group [12]. Parameters measured included vector volume, high pressure zone lengths and percentage asymmetry (at rest and during sustained squeeze). Balloon inflation was conducted to assess the rectoanal inhibitory reflex (an IAS function), with measurements of reflex parameters as previously described by our group [13]. Parameters included excitation and inhibition latencies, maximal excitatory and inhibitory pressures, area under the inhibitory curve, recovery time of the inhibition wave and inhibition amplitude.

Operative technique

This initially employed drainage of perirectal sepsis, when appropriate, by incision and drainage in accordance with stan-

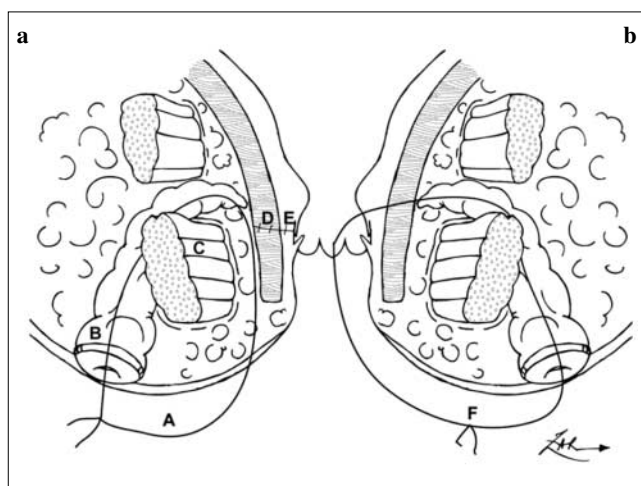


Fig. 1a, b Techniques for repair of high trans-sphincteric fistula. **a** IAS-preserving technique combines a short mucosal flap (not incorporating the IAS musculature) to close the internal fistula opening, an IAS repair and a rerouting of the seton (for EAS cutting) through the intersphincteric space. **b** Conventional cutting seton. *A*, seton; *B*, high trans-sphincteric fistula; *C*, external anal sphincter (EAS); *D*, internal anal sphincter (IAS) repair; *E*, mucosal advancement repair; *F*, conventional cutting seton

dard surgical practice (Fig. 1) [14]. Full bowel preparation with polyethylene glycol solution was only used in patients undergoing the IAS-preserving technique after permitting the sepsis to resolve. In these cases, the fistula was identified using Lockhart-Mummery directors with the patient in the prone position. After infiltration with adrenaline (1:200000), the internal opening was excised creating a U-shaped mucosal flap which did not incorporate the IAS musculature. A suture of 2/0 polyglactin was placed in the IAS through the mucosal flap and the intersphincteric space was dissected for rerouting the fistula by inserting a 0-nylon seton suture across the EAS. The seton was passed submucosally and subcutaneously with tightening at 2-week intervals in the clinic using a rubber band ligator technique until the seton had fully cut through [15] (Fig. 1). In 4 patients in each group, where the seton had passed well below the puborectalis sling on clinical follow-up but where its passage was deemed to be slow, a secondary fistulectomy was performed across the EAS to complete the procedure.

Statistical analysis

Prospectively collected data for patients was compared using independent *t* tests. Comparisons between groups of manometric and rectoanal inhibitory reflex variables were made using analysis of variance (ANOVA). For all analyses, residuals were assumed to follow a Gaussian distribution with confirmation of normality using the Shapiro Francia W test and Bartlett's test for equality of variances. When these assumptions were not valid, a natural logarithmic transformation was made, with geometric means (plus 95% confidence intervals) being shown for log-normal data. A value of $p < 0.05$ was considered significant.

Results

Thirty four patients (25 males) were included in the trial (Table 1). Eighteen patients (12 men; mean age, 39.9 years; range, 29–46 years) were treated by the IAS-preserving technique; 16 patients (13 men; mean age, 36 years; range, 22–58 years) were treated by conventional seton. There was no difference in the number of prior surgeries for either group or in the mean preoperative continence score. The average healing time for each group was equivalent (14 and 12 weeks, respectively). Postoperatively, one patient had intermittent lack of control of flatus with the IAS-preserving technique

and 2 patients presented after the conventional seton surgery with continence problems: one with incontinence for flatus and the other with occasional passive fecal leakage. There were no cases of intersphincteric sepsis in the IAS-preserving technique, where the intersphincteric space had been dissected to reroute the seton.

Median follow-up in the group with IAS-preserving technique was 13 months (range, 6–30 months). In this group, 2 patients experienced recurrent fistulas at the original site, at 4 and 6 months. In the conventional seton group, median follow-up was 12 months (range, 5–28 months). One patient in this group had a recurrent fistula at 6 months as a new track away from the primary fistula site.

Table 1 Characteristics of patients with high cryptogenic fistula-in-ano, by treatment group

	IAS-preserving seton	Standard cutting seton
Number	18 (12 males)	16 (13 males)
Age, median (range)	38 years (29–46)	34 years (22–58)
Prior operations	4 (4–11; 3 months–8 years)	5 (3–19; 6 months–6 years)
Follow-up, median (range)	13 months (6–30)	12 months (5–28)
Continence score ^a		
Preoperative	1 (0–1)	1 (0–2)
Postoperative	1* (6)	2** (5.8)
Mean healing time	14 weeks (6–38 weeks)	12 weeks (4–28 weeks)
Recurrence	2 (11%; 4/6 months)	1 (6.6%; 6 months)

*,** Individual cases

^a Scoring according to Pescatori et al. [11]

Table 2 Resting manometric parameters for IAS-preserving and conventional seton groups, compared with controls. Values are mean (SD)

	Controls	IAS-preserving seton		Conventional seton	
		Preop	Postop	Preop	Postop
MRAP, mmHg	99 (17.1)	121.9 (8.0)	106.1 (3.8)*	132.1 (11.0)	80 (16.1)*
HPZ length, mm ^a	38.1 (9.9)	37.0 (5.5)	21.1 (6.0)**	37.5 (6.6)	17 (5.0)***
Asymmetry, %	31.1 (3.4)	30.4 (10.0)	29.9 (1.0)	30.6 (7.0)	39 (7.1)
MRVV	51890.1 (6372.2)	111001 (2005.1)	37800.7 (8010.0)*	113005 (5711.1)	25099.9 (8112.9)***

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.005$; ^a Measured at rest

MRAP, mean resting anal pressure; HPZ, high pressure zone; MRVV, mean resting vector volume

Table 3 Squeeze manometric parameters for controls and for IAS-preserving and conventional seton groups, compared with controls. Values are mean (SD)

	Controls	IAS-preserving seton		Conventional seton	
		Preop	Postop	Preop	Postop
MSP, mmHg	203.9 (35.4)	205 (60.4)	120.7 (20.0)	10.7 (45.0)	104 (9.1)*
HPZ length, mm ^a	35.9 (3.1)	34 (8.4)	26.1 (11.0)	29.4 (11.9)	21.3 (5.0)
Asymmetry, %	28.6 (3.4)	30 (10.1)	31.1 (5.0)	34.4 (10.1)	34 (11.1)
MSVV	152622 (39120.2)	159666.1 (4004.9)	50224.2 (17001.4)	149679.9 (45088.0)	53806.7 (9108.8)**

* $p < 0.05$; ** $p < 0.01$; ^a Measured at rest

MSP, mean squeeze pressure; HPZ, high pressure zone; MSVV, mean squeeze vector volume

Table 4 Area under the inhibitor curve (AUC) of rectoanal inhibitory reflex for IAS-preserving and conventional seton groups, compared with controls. Values are mean (SD)

Sphincter	Controls	IAS-preserving seton		Conventional seton	
		Preop	Postop	Preop	Postop
Distal	1692.72 (169.1)	1223.9 (550.5)	1225.6 (299.9)	1274.4 (500.2)	504 (233.3)*
Intermediate	638.21 (67.3)	771.0 (400.6)	900.1 (435.5)	1222.2 (400.7)	499.1 (20.1)**
Proximal	647.58 (170.6)	599.9 (270.7)	590.6 (177.7)	793.3 (418.0)	400.3 (280.4)

* $p < 0.05$; ** $p < 0.01$

There were no preoperative differences between patients and controls with regard to resting manometric parameters (Table 2). There were no preoperative differences between patients and controls with regard to squeeze parameters (Table 3). Examination of all parameters of the rectoanal inhibitory reflex only showed differences between groups for the area under the inhibitory curve (AUC, Table 4). No differences were noted between controls and patients before surgery. The differences in measured AUC at all sphincter levels were significant when the two operative groups were compared ($p < 0.05$).

Discussion

This prospective study combined closure of the internal fistula opening of high cryptogenic trans-sphincteric fistulas by mucosal advancement with IAS repair, and rerouting the seton through the intersphincteric space for EAS division alone. There was no difference noted in postoperative clinical continence between the two procedures, although the numbers of patient were small. The IAS-preserving procedure was shown to be safe and effective. There were no differences between the groups in terms of postoperative resting or squeeze manometry, although the AUC of the rectoanal inhibitory reflex was maintained across the full sphincter length in the IAS-preserving technique when compared with patients where conventional cutting setons were used. One of the weaknesses of this preliminary study is that given such small patient numbers, we cannot draw hard conclusions about whether this modified seton technique is advantageous for patients with regard to their clinical continence. The manometric data provided in this series, although valuable and suggestive of maintenance of resting function is no substitute for patients' reporting of their continence status when such a new technique is employed.

A review of the literature (Table 5) concerning the use of cutting setons (where prospectively collected data reporting clinical continence or manometry could be interpreted) shows that although conventional seton use is efficient at fistula eradication, it may leave patients with significant functional problems [2–4, 7, 16–19]. The differences in functional outcome following cutting seton use are varied and the causes for such

variation are multifactorial. In some cases, it may depend upon the volume of IAS or EAS damage caudal to the advancing seton, while in others, the presence of septic episodes (which may or may not be reported or recognized) during interim seton advancement and tightening will result in unexpected sphincter destruction. Still others may have constitutively variable distal IAS/EAS overlap where the consequences of any IAS destruction may be critical [20]. Our modified technique combines the simplicity of the cutting seton technique with preservation of the IAS distal to the internal fistula opening.

Recently, less favorable outcomes have been reported with formal mucosal advancement anoplasty and EAS sphincteroplasty [21]. Worse outcomes for this procedure appear to correlate with the number of prior attempts at fistula repair [22] and possibly with the incorporation of part of the IAS muscle to strengthen the quality of the mucosal flap [23]. Our technique is also associated with less prolonged endoanal distraction than that experienced during formal mucosal advancement anoplasty [24, 25] and in theory, could be more readily performed in patients by less experienced surgeons who are unfamiliar with formal fistula dissection through the sphincter and its attendant repair. The hypothesis that IAS preservation in fistula repair is important is suggested by previous work from our group (and others), showing that more rapid recovery of the rectoanal inhibitory wave occurs in patients presenting with fecal incontinence and EAS atrophy [13], implying that inherent IAS parameters function as a continence defense mechanism when continence is already compromised [26]. Moreover, we have prospectively demonstrated differences in the MRAP, MRVV and rectoanal inhibition in patients who remain continent following open lateral internal sphincterotomy for topically resistant chronic anal fissure when compared with those who report soiling after this procedure [27, 28], suggesting that IAS preservation may be advantageous in the surgery for other conditions including high trans-sphincteric anal fistula. For these reasons, it is probable that simple IAS preservation through the use of a modified seton may result in improvement in postoperative continence. Our findings do not, however, prove this point, but the relative ease of the procedure justifies a larger study.

The factors implicated in fistula recurrence include the complexity and level of the fistula, the presence or absence

Table 5 Use of seton for cryptogenic high fistula-in-ano (with available data concerning continence)

Reference	Patients, n	Age, years ^a	Incontinence, n (%)		Healing time ^a	Follow-up, mean	Recurrence, n (%)
			Preop	Postop			
Kennedy, Zagarra [2]	32	NS	NS	23 (62)	2–17 weeks	36 months (13–65 months)	1 (3.1)
Williams, Macleod [3]	74	42 (29–74)	NS	13 (17.6)	16 weeks (8–36 weeks)	NS	2 (8)
Isbister, Al-Sanea [4]	47	NS	13 (27.7)	22 (46.9)	6 months	12 months	1 (2.1)
McCourtney, Finlay [7]	27	45 (21–27)	0 (0)	3 (11)	5 months (1–19 months)	NS	1 (3.6)
Lentner, Wienert [17]	108	NS	NS	2 (0.9)	54.8 weeks	NS	4 (3.7)
Hämäläinen, Sainio [18]	44	42 (21–76)	4 (10)	22 (63)	87 days	151 days	2 (6)
Dziki, Bartos [19]	33	45 (33–70)	NS	9 (36.7)	5.5 months (14 days–6 months)	NS	0 (0)
Present series	34	38.9 (29–68)	0 (0)	3 (8.8) (29–68)	12–14 weeks	12.5 months	3 (8.8)

NS, not stated; ^a Values are mean (range)

of a horseshoe extension, the degree of laterality of the external opening, failure by the surgeon to identify the internal opening at initial surgery and the overall surgical experience of the operator in complicated proctologic practice [29].

It is well recognized that there is no clear correlation between manometric data and clinical symptomatology in a range of anorectal disorders [30]. In our study, the resting manometric parameters such as MRAP, HPZ length and MRVV were higher after the IAS-preserving technique, although the results were not statistically significant; this effect is attributed to IAS repair. This was coupled with a maintenance of the area under the inhibitory curve during elicitation of the rectoanal inhibitory reflex right across the sphincter when the IAS was not involved in the seton advancement. The reduction of squeeze parameters consequent upon EAS division by the advancing seton did not differ between the two groups; this effect was expected by the similarity of EAS division between the two surgical techniques. This result has important clinical consequences, since it has been shown that preoperative manometric assessment of high-risk, often multiply operated patients may permit the coloproctologist to tailor fistula surgery, where the more selective use of setons which limit IAS and EAS division can be directed by low preoperative resting and squeeze pressures [31]. This approach, particularly when adopted for trans-sphincteric and suprasphincteric cryptogenic fistulas, appears to result in a reduction in reported postoperative soiling without substantial increases in fistula recurrence [32].

The causes of incontinence after such surgery appear to be multifactorial and do not just reflect how much sphincter musculature has been divided. In some cases, the technique of the fistulectomy performed may lead to anal canal guttering and distortion of the EAS shape and integrity, resulting in postoperative fecal leakage [9]. In others, significant post-surgical blunting of mucosal electrosensitivity may correlate with function and reflect the degree of perianal scarring [5]. In some studies, there is considerable variability of patient reporting of incontinence symptoms including leakage, seepage and soiling (quite apart from frank incontinence), with differences dependent upon the timing of assessment and the type of questionnaire utilized. It is likely that this form of reporting would be improved by the use of better questionnaires based on prospectively validated symptom weighting, incorporating patient-supplied data and specifically designed for the postoperative fistula patient [33].

The approach by the coloproctologist towards complex recurrent high fistula-in-ano should be individually based on his or her experience and judgement. It is probably unwise to use cutting setons in patients who already have impaired continence before surgery, or in multiparous women with high anterior trans-sphincteric fistulas [18], but it is also clear that mucosal advancement anoplasty may not be an alternative in some patients who have undergone numerous previous operations and who exhibit extensive endoanal scarring. For these patients, fibrin adhesive [34], long-term

drainage seton use, cutaneous advancement anoplasty [35], labial fat pad interposition [36] or even a proctectomy (or colostomy) may be the only alternatives. These new techniques all require prospective manometric and clinical assessment to determine their place in selected patient management. Based on these preliminary results, a larger study to assess the clinical role of IAS-preserving cutting seton is justified in high and recurrent trans-sphincteric fistula-in-ano. If successful, the technique could be trialed in selected patients with perianal Crohn's disease.

References

- Pearl RK, Andrew JR, Orsay CP (1993) Role of the seton in the management of anorectal fistulas. *Dis Colon Rectum* 3:573–578
- Kennedy, Zegarra JP (1990) Fistulotomy without external sphincter division for high anal fistulae. *Br J Surg* 77:898–901
- Williams JG, Macleod CA, Rothenberger DA, Goldberg SM (1991) Seton treatment of high anal fistulae. *Br J Surg* 78:1159–1161
- Isbister WH, Al Sanea N (2001) The cutting seton: an experience at the King Faisal Specialist Hospital. *Dis Colon Rectum* 44:722–727
- Lunniss PJ, Kamm MA, Phillips RKS (1994) Factors affecting continence after surgery for anal fistula. *Br J Surg* 81:1382–1385
- Thompson JPS, Ross AHMcL (1989) Can the external anal sphincter be preserved in the treatment of trans-sphincteric fistula-in-ano? *Int J Colorectal Dis* 4:247–250
- McCourtney JS, Finlay IG (1996) Cutting seton without preliminary internal sphincterotomy in management of complex high fistula-in-ano. *Dis Colon Rectum* 39:55–58
- Matos D, Lunniss PJ, Phillips RKS (1993) Total sphincter conservatoin in high fistula-in-ano: results of a new approach. *Br J Surg* 80:802–804
- Mann CV, Clifton MA (1985) Re-routing of the track for the treatment of high anal and anorectal fistulae. *Br J Surg* 72:134–137
- Ortíz H, Marzo J (2000) Endorectal flap advancement repair and fistulectomy for high trans-shincteric and suprasphincteric fistulas. *Br J Surg* 87:1680–1683
- Pescatori M, Anastasio G, Bottini C, Mentasti A (1992) A new grading of fecal incontinence. Evaluation of 335 patients. *Dis Colon Rectum* 35:482–487
- Zbar AP, Aslam M, Hider A, Toomey P, Kmiot WA (1998) Comparison of vector volume manometry with conventional manometry in anorectal dysfunction. *Tech Coloproctol* 2:84–90
- Zbar AP, Aslam M, Gold DM, Gatzon C, Gosling A, Kmiot WA (1998) Parameters of the rectoanal inhibitory reflex in patients with idiopathic fecal incontinence and chronic constipation. *Dis Colon Rectum* 41:200–208
- Corman ML (1989) *Colon and rectal surgery*, 2nd edn. Lippincott, Philadelphia
- Goldberg SM, Garcia-Aguilar J (1996) The cutting seton. In: Phillips RKS, Lunniss PJ (eds) *Anal fistula: surgical evaluation and management*. Chapman Hall, London, pp 95–102
- Graf W, Pählman L, Ejerblad S (1995) Functional results after seton treatment of high transsphincteric anal fistulas. *Eur J Surg* 161:289–291
- Lentner A, Wienert V (1996) Long-term indwelling setons for low transsphincteric and intersphincteric anal fistulas. Experience with 108 cases. *Dis Colon Rectum* 39:1097–1101
- Hämäläinen KP, Sainio J (1997) Cutting seton for anal fistulas. High risk of minor control defects. *Dis Colon Rectum* 40:1443–1447
- Dziki A, Bartos M (1998) Seton treatment of anal fistula: experience with a new modification. *Eur J Surg* 164:543–548
- Zbar AP, Kmiot WA, Aslam M et al (1999) Use of vector volume manometry and endoanal magnetic resonance imaging in the adult female for assessment of anal sphincter dysfunction. *Dis Colon Rectum* 42:1411–1418
- Ozuner G, Hull TL, Cartmill J, Fazio VW (1996) Long-term analysis of the use of transanal rectal advancement flaps for complicated anorectal/vaginal fistulas. *Dis Colon Rectum* 39:10–14
- Schouten WR, Zimmerman DDE, Briel JW (1999) Transanal advancement flap repair of trans-sphincteric fistulas. *Dis Colon Rectum* 42:1419–1422
- Gustafsson UM, Graf W (2002) Excision of anal fistula with closure of the internal opening. Functional and manometric results. *Dis Colon Rectum* 45:1672–1678
- Li L, Zhang JZ, Lu GW, He GR, Lui XH (1996) Damaging effects of anal stretching on the external anal sphincter. *Dis Colon Rectum* 39:1249–1254
- van Tets WF, Kuijpers JHC, Tran K, Mollen R, van Goor H (1997) Influence of Parks' anal retractor on anal sphincter pressures. *Dis Colon Rectum* 40:1042–1045
- Kaur G, Gardiner A, Duthie GS (2002) Rectoanal reflex parameters in incontinence and constipation. *Dis Colon Rectum* 45:928–933
- Zbar AP, Aslam M, Allgar V (2000) Faecal incontinence after internal sphincterotomy for anal fissure. *Tech Coloproctol* 4:25–28
- Zbar AP, Beer-Gabel M, Chiappa AC, Aslam M (2001) Fecal incontinence after minor anorectal surgery. *Dis Colon Rectum* 44:1610–1623
- Garcia-Aguilar J, Belmonte C, Wong WD, Goldberg SM, Madoff RD (1996) Anal fistula surgery. Factors associated with recurrence and incontinence. *Dis Colon Rectum* 39:723–729
- Lieberman H, Faria J, Ternent CA, Blatchford GJ, Christensen MA, Thorson AG (2001) A prospective evaluation of the value of anorectal physiology in the management of fecal incontinence. *Dis Colon Rectum* 44:1567–1574
- Pescatori M, Maria G, Anastasio G, Rinallo L (1989) Anal manometry improves the outcome of surgery for fistula-in-ano. *Dis Colon Rectum* 32:588–592
- Belliveau P, Thompson JP, Parks AG (1983) Fistula-in-ano: a manometric study. *Dis Colon Rectum* 26:152–154
- Rockwood TH, Church JM, Fleshman JW et al (1999) Patient and surgeon ranking of the severity of symptoms associated with fecal incontinence. *Dis Colon Rectum* 42:1525–1532
- Cintron JR, Park JJ, Orsay CP, Pearl RK, Nelson RL, Abcarian H (1999) Repair of fistulas-in-ano using autologous fibrin tissue adhesive. *Dis Colon Rectum* 42:607–613
- Kohler A, Athanasiadis S (1996) Anodermal advancement flap-plasty as alternative treatment in therapy of high anal fistulas. A prospective study of 31 patients. *Chirurg* 67:1244–1250
- Zimmerman DDE, Gosselink MP, Briel JW, Schouten WR (2002) The outcome of transanal advancement flap repair of rectovaginal fistulas is not improved by an additional labial fat flap transposition. *Tech Coloproctol* 6:37–42