Transanal endoscopic microsurgery: clinical and functional results

G. Dafnis, L. Påhlman, Y. Raab, U.-M. Gustafsson and W. Graf

Department of Surgery, University Hospital, Uppsala, Sweden

Abstract

Objective Transanal endoscopic microsurgery (TEM) has become increasingly common in the management of rectal adenomas and also in selected cases of rectal carcinomas. The aim of this study was to assess the results in a consecutive series of patients after introducing the TEM technique.

Patients and methods All 58 patients operated with TEM from January 1996 to January 1999 were evaluated in a retrospective review. Forty-eight patients answered a clinically validated questionnaire a median of 22 months after TEM. Eighty patients who had undergone transanal excision and 12 who had undergone York Mason's procedure served as a reference group with respect to recurrence rates.

Results The complication rate was 5% (immediate) and 14% (long-term). The overall 30-day mortality rate was zero. An impairment of continence was seen in 18 (37%) patients. Of these, all 18 experienced varying degree of incontinence to liquid stool, 14 also to flatus and 5 of them even to solid stool. The recurrence rate was 11% in adenomas and 14% in cancers; T1, 1 (10%) recurrence and T2, 1 (50%) recurrence. There was a correlation between operating time and impairment of continence as well as recurrence rate.

Conclusion TEM is a safe procedure, having a low recurrence rate and an acceptable functional outcome.

Keywords Transanal endoscopic microsurgery, functional results, recurrence rate

Introduction

Transanal endoscopic microsurgery (TEM) was introduced in 1983 [1]. Since then, the technique has become increasingly common in the management of rectal adenomas and also in selected cases of rectal carcinomas [2–5]. Previous studies have shown that TEM offers considerable advantages compared to transanal excision, mostly by a more precise dissection and improved exposure of the rectal lesion [2,5]. The most important outcome is the recurrence rate, but the functional results of different approaches have successively gained more weight in the discussion [5–11]. Another advantage is a lower rate of morbidity and mortality compared to abdominal resections of rectal lesions [12].

The aim of this study was to assess the results after TEM in a consecutive series of patients with rectal lesions and to compare the recurrence rate with that of transanal excision.

Correspondence to: Dr George Dafnis, Department of Surgery, University Hospital, SE-751 85 Uppsala, Sweden.
E-mail: george.dafnis@telia.com

Patients and methods

TEM patients

In January 1996, TEM was introduced at the Department of Surgery, University Hospital, Uppsala, Sweden and the records of all 58 patients operated with TEM up to January 1999 were reviewed. Of 55 patients still alive in April 1999, 2 had undergone an abdomino-perineal resection. To assess the functional results, a clinically validated questionnaire [13] concerning bowel function, was mailed to 53 eligible patients. Since our questionnaire included the information used in the Wexner score as well as that of the Kamm score these scores were also calculated [14]. Forty-eight (91%) patients responded, a median of 22 months (range 3–40 months) after TEM. Of 58 patients, there were 30 men and 28 women. The mean age was 68 years (range 31–88 years) and median length of follow up was 8 months (range 2–33 months). A total of 19 (33%) patients were referrals from other counties. Rectal polyps and cancer were the two most common indications (Table 1). A quarter of the patients had comorbidities, mainly cardiovascular disease ($n = 13$,

22%) or diabetes ($n = 2$, 3%). Two patients had previously been operated on in the anal canal.

We defined incontinence to be due to TEM when the questionnaire confirmed both some degree of incontinence to solid stool and a postoperative deterioration.

We defined urgency to be due to TEM when the questionnaire confirmed a deferral time of 10 min or less and complaints of urgency were noted in the records.

Reference patients

Eighty patients who had undergone transanal excision and 12 patients who had undergone York Mason's procedure (posterior transsphincteric incision with the patient in the prone jack-knife position) [15] at the same unit from September 1976 to December 1996 served as a reference group with respect to recurrence rates. Of 92 patients, 43 were men and 49 women. The mean age was 69 years (range, 39–96 years) and median length of

Table 1 Pre-operative characteristics of 58 TEM procedures.

Pre-operative characteristics	n	(%)
Total	58	
Indications		
Polyp	42	72
Polyp recurrence	5	9
Cancer	10	17
Unclear	1	2
Comorbidities	15	26
Pre-operative workup		
Endorectal ultrasonography*	27	47
Benign	23	85
Benign submucus tumour	1	4
Infiltrating muscularis propria	1	4
Unclear	2	7
Barium enema*	17	29
Polyp	13	76
Normal	3	18
Cancer	1	6
Colonoscopy*	24	41
Polyp	20	83
Normal	2	8
Incomplete colonoscopy	1	4
Unclear	1	4
Histology*	42	72
Adenoma	32	76
Cancer	6	14
Carcinoid	1	2
Unclear	3	7

* Percentage by findings are percentage of those undergoing the investigation specified.

follow up was 18 months (range 0–208 months). During this period an additional eight patients had been operated either by transanal approach or by York Mason's procedure but their records could not be found.

During the study period January 1996 to January 1999, 114 anterior resections, 45 abdominoperineal resections, 2 York Mason's procedures and 25 transanal excisions were performed.

The study was approved by the Regional Research Ethics Committee.

Pre-operative investigation

The pre-operative investigation included endorectal ultrasonography in selected patients and colonoscopy and/or barium enema in the majority of the patients (Table 1). Ultrasonography was not carried out if the lesion was without doubt considered benign. Pre-operatively bowel cleansing was performed with a balanced electrolyte solution with polyethylene glycol and prophylactic oral antibiotics were given. The histology of the TEM specimen showed adenoma in 44 (76%) patients, carcinoma in 12 (21%), carcinoid in 1 (2%), and fibrosis in 1 (2%). Histology of the specimen from the transanal excisions and York Mason's procedures showed adenoma in 81 (88%) patients, carcinoma in 10 (11%) and carcinoid in 1 (1%). Thus, there was no difference in the benign/malignant ratio between the patients undergoing TEM compared to those undergoing transanal excision or York Mason's procedure (χ^2 2.17, 1df, $P = 0.14$). In the adenoma patients, the resection was classified by the pathologist as microscopically radical in 26 (59%), not microscopically radical in 8 (19%) and of uncertain microscopical radicality in 10 (23%). In the cancer patients, the corresponding figures were 8 (67%), 0 and 4 (33%), respectively.

The mean distance from the anal verge and the size of the lesions in TEM procedures was 8.8 cm and 3.3 cm, while the corresponding distance and size in the transanal excisions were 5.6 cm and 2.4 cm and in the York Mason's procedure 7.9 cm and 3.8 cm.

Surgical methods

Except for a few operations performed under spinal anaesthesia early in the series, the operations were performed under general anaesthesia. All TEM procedures were performed by three surgeons. The instrumentation used was manufactured by Wolf Company, Knittlingen, Germany. The patients were positioned either in lithotomy, prone or lateral decubitus depending on the location of the lesion. The procedures were

performed according to the technique described by Buess [2]. The intra-operative characteristics of the procedures are presented in Table 2. Modifications of the TEM procedure were performed in seven patients. Because of distal location of the defect in the bowel wall, transanal sutures had to be placed in five patients. In one patient was the area of the resection left unsutured, and one large adenoma was removed by piece-meal technique. A full thickness excision was performed when possible, i.e. when the lesion was located anteriorly below the peritoneal reflection and also when it was located posteriorly above the peritoneal reflection.

Follow up

The postoperative follow-up for patients with adenoma comprised digital examination and rigid rectoscopy at six months intervals. Cancer patients also underwent endorectal ultrasonography and they were examined at three-month intervals.

Table 2 Intra-operative characteristics of 58 TEM procedures.

Intra-operative characteristics	*n*	(%)
Total	58	
Operating time (min)		
Mean; median	151; 135	
First 29 procedures	163; 155*	
Subsequent 29 procedures	138; 129*	
Range; IQR	18–575; 90–190	
Blood loss (ml)		
Mean; median	145; 0	
First 29 procedures	203; 100†	
Subsequent 29 procedures	86; 0†	
Range; IQR	0–1000; 0–150	
Tumour (cm)		
Distance from anal verge (median; range)	8; 3–20	
Size (median; range)	3; 1–10	
Position		
Lithotomy	21	36
Left decubitus	19	33
Right decubitus	10	17
Prone	9	16
Changed	1	2
Multiple procedures	2	3
Complications‡	2	3

*$P = 0.12$, and †$P = 0.25$

Mann–Whitney U-test;

‡ 1 perforation of upper rectum, anterior resection performed, 1 rupture of internal anal sphincter and partial rupture of external anal sphincter when introducing theTEM-instrument.

Statistical methods

Comparisons between groups were performed using the Mann–Whitney U-test for continuous data, the χ^2 test with Yates correction was used to compare proportions, and the Fisher exact test was used to test smaller contingency table data. Results are expressed as two-tailed levels of probability. A P-value of < 0.05 was considered significant. The cumulative recurrence rates were calculated according to the method of Kaplan and Meier.

Results

Intra-operative complications

The intra-operative complication rate was 3% ($n = 2$). One patient had a perforation of the upper rectum, necessitating an anterior resection, and one patient with fibrosis of the anal canal following treatment for anal fistula had a rupture of the sphincters when the TEM-instrument was introduced. When the TEM procedure was completed, the surgeon noticed a rupture of the anal canal including the internal anal sphincter and a part of the external anal sphincter. The sphincters were repaired immediately and the postoperative course was uneventful.

In six patients, of whom five were among the first half of the series, the blood loss was more than 500 ml.

Postoperative complications

Immediate postoperative complications were seen in 3 (5%) patients, chest pain, neuralgia of the perineum and dehiscence of the suture line. The diagnosis was made 11 days after the TEM procedure. There were clinical signs of incipient perineal sepsis necessitating a loop sigmoidostomy and lavage of the cavity. The histology of the TEM specimen showed T2 carcinoma classified as microscopically radical but a recurrence was diagnosed within five months (further details are presented in the recurrence paragraph).

Long-term complications were seen in 8 (14%) patients. These were incontinence, $n = 3$ (5%), stricture, $n = 1$ (2%), urgency, $n = 2$ (3%) and neuralgia of the perineum, $n = 2$ (3%). Both patients with neuralgia were men. Both were eventually operated on with abdominoperineal resections, in one because of persistent neuralgia, and in the other because of recurrence. In both patients, the neuralgia disappeared following the abdominoperineal resection. Regarding modifications of the TEM procedure, in the five patients in whom transanal sutures were placed there was no correlation to the postoperative incontinence score.

Clinical course

The overall 30-day mortality rate was zero. The median postoperative length of stay was 3 days (range 1–21 days). In the patient in whom a loop sigmoidostomy was carried out because of dehiscence length of stay was 14 days, and in the patient in whom an anterior resection was performed because of perforation of the upper rectum length of stay was 21 days.

Functional results

Two thirds of the patients reported that the TEM procedure had had no impact on continence, and four fifths reported no impact on bowel emptying (Table 3). Eighteen (37%) patients experienced an impairment of continence as a result of TEM. Of these, all 18 experienced varying degree of incontinence to liquid stool, 14

Table 3 Functional outcome in 48 TEM patients.

	n	(%)
Total	48	
Incontinence of gas		
Never	14	29
Less than daily	30	63
Daily	4	8
Incontinence of liquid stool		
Never	23	48
Less than daily	24	50
Daily	1	2
Incontinence of solid stool		
Never	41	85
Less than daily	6	13
Daily	1	2
Bowel function impairing social activity		
Never	35	73
Slightly	13	27
Substantially	0	
Impact of surgery on continence		
Unchanged	30	63
Impaired	17	35
Almost incontinent	1	2
Impact of surgery on emptying		
Unchanged	38	79
Impaired	10	21
Almost impossible	0	
Daytime use of a pad	14	29
Nocturnal use of a pad	3	6
Retrospective consent to TEM		
Yes	42	88
Can not decide	4	8
No	2	4
Stoma preference	0	

also to flatus and 5 of them even to solid stool. In 13 patients assessed within one year after surgery, six reported impaired continence after surgery and in 35 patients assessed more than one year after surgery, 12 reported impaired continence ($P = 0.51$). Thus, we were not able to detect any changes in continence over time. In comparison with our scoring system, the functional outcome over time remained unchanged using the Wexner score as well as the Kamm score (data not shown). There was no correlation between age or gender and impairment of continence (data not shown). However, there was such a correlation concerning operating time (mean 175 *vs.* 117 min; U 158.0, $P = 0.017$). Only 2 patients (4%) would not have consented to a TEM procedure in retrospect. No patient would have preferred an operation comprising an ostomy if this had been an alternative to TEM.

Recurrence rates

The recurrence rate was 11% (5/44) in adenomas, and 14% (2/14) in cancers (Table 4). The histopathological staging in relation to recurrences was: T1, 10, 1 (10%) recurrence; T2, 2, 1 (50%) recurrence. No significant difference could be shown with regard to gender, age, distance from the anal verge, size of the lesion, blood loss, or microscopically radical resection between this group of seven patients with recurrence and the group of 51 patients without recurrence (data not shown). However, there was a significant difference with regard to the operating time (mean operating time 224 min *vs.* 141 min; U 92.0 $P = 0.039$).

The cumulative proportion of adenoma patients without recurrence was higher in the York Mason group and in the TEM group than in the transanal group ($\chi^2 = 6.32$, d.f. = 2, $P = 0.042$, Fig. 1).

Discussion

We found low morbidity, no 30-day mortality, and a relatively low rate of recurrence compared to the recurrence rate of transanal excision. Both the operating time and the blood loss decreased by increased experience of the surgeons. There was a positive correlation between operating time and impairment of continence as well as recurrence rate. The functional outcome was acceptable.

The recurrence rate after TEM for adenomas was 11%, in line with previous reports presenting recurrence rates between 0% and 14% [2,5,16–26]. The recurrence rates after TEM for adenomas are substantially lower than the recurrence rates of 21–27% reported after transanal excision [27,28]. However, there are reports of low recurrence rates (3.7–8%) also after transanal excision for

Table 4 Details of the patients with recurrence.

Gender	Age	Tumour		Procedure time (min)	Blood loss (ml)	Histology of TEM specimen	Microscopically radical resection	Subsequent procedure	Histology of specimen
		Distance from anal verge (cm)	Size (cm)						
Male	45	12	Not noted	125	150	Tubulovillous II	Not noted	TEM	Tubular III
Male	57	8	4	230	50	Tubulovillous III	Yes	TEM	Tubulovillous II
Male	62	6	4	215	900	Tubulovillous + T1 carcinoma	No	TEM	Tubulovillous III
Male	69	6	6	225	1000	T2 carcinoma	Yes	50 Gy + APR	No residual carcinoma
Male	73	10	5	395	600	Tubulovillous III	Not noted	TEM	Tubulovillous III
Male	82	5	1	70	100	Tubular II	Yes	TEM	Villous III‡
Female	70	4	6	307	50	Tubulovillous III	Not noted	TEM	Tubulovillous III§

* I, slight dysplasia; II, moderate dysplasia; III, severe dysplasia. ‡Because of recurrence, a repeat TEM procedure was performed, the histology of the specimen also showed villous dysplasia III. §Because of recurrence, a repeat TEM procedure was performed, the histology of the specimen showed villous dysplasia III.
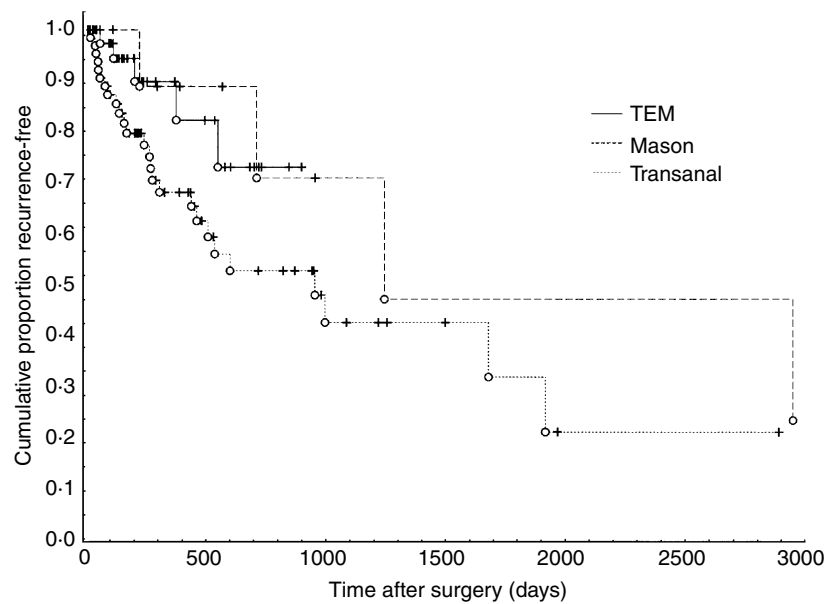
	Patients	Recurrence (%)
TEM	44	5 (11.4)
Mason	10	4 (40.0)
Transanal	71	26 (36.0)
Total	125	35 (28.0)

Figure I Cumulative proportion recurrence-free cases among patients with adenoma. $\chi^2 = 6.11$ d.f. $= 2$ $P = 0.047$. —— TEM; - - - - Mason; ········ Transanal. + end of follow up ○ recurrance.

adenomas [29–31]. We found a recurrence rate of 14% after TEM for cancer. The number of cancer patients ($n = 14$) was small and two recurrences results in a relatively high recurrence rate. Thus, in this respect the material is too small for statistical analysis of recurrence. The cancer recurrence rates vary considerably in different reports (0–10% T1, 33% high risk T1; 6.3–40% T2; 66%

T3) [2–5,18,20,22–26,32,33]. Our recurrence rates should be regarded as minimum figures in view of the relatively short follow up, and the 'true' recurrence rates may be higher both in the TEM cases and in the reference group. The only intra-operative characteristic, which differed between the 7 patients with and the 51 patients without recurrence, was operating time. A longer

operating time may indicate a more difficult procedure and a higher risk of recurrence. It may also reflect a learning curve.

We found a shorter operating time and reduced blood loss, although not statistically significant, both decreased with increased experience of the surgeon, in conformity with previous reports [4,5,19].

Although TEM is controversial in resection of carcinoma with curative intent, many authors agree that in low risk T1 carcinoma the risk of recurrence is smaller than the morbidity and mortality of an abdominal operation [16,18,23,32–34].

We experienced only two intra-operative complications, and one major and two minor immediate postoperative complications. This confirms previous reports of low intra-operative and immediate postoperative complications [4,5,17,18,20–23].

During the course of the study period we have learned that the very distal rectal lesion, i.e. distal margin of the lesion less than six cm from the anal verge in males and five cm in females is preferably managed with conventional transanal excision. We have also realized that general anaesthesia is superior to regional, since movements of the patient may complicate the procedure. We have also learnt that full thickness excision is preferred since this technique fulfils the criteria of local radicality if a cancer is incidentally found.

The long-term functional outcome was acceptable. However, 37% of the patients responding to the questionnaire concerning bowel function experienced an impairment of continence as a result of TEM. This figure is rather high compared to previous reports and we were not able to show an improvement over time previously reported [32,35–37]. Operating time seemed to influence impairment of continence. The length of time by which the sphincters are distended by the TEM instrument might be the underlying cause. Distension of the sphincters by the use of Parks' anal retractor have been shown to decrease mean resting pressure [38], and prolonged distension by the TEM instrument will result in a fall in mean resting pressure. This has been found to be significantly correlated with length of operating time [39]. However, in contrast to our results other authors have shown that even if objective function was impaired clinical function was adequate [39,40].

It would have been interesting to compare the long-term functional outcome of the TEM procedures to that of the transanal excisions and the York Mason's procedures but we considered that the long time period that had elapsed since the operation, median 130 months (range 29–275 months) would make such a comparison difficult.

In this small material, York Mason's procedure seemed to be equal to TEM, and superior to transanal excision regarding the risk of recurrence. Although York Mason's procedure is associated with a risk of postoperative fistulae and wound infection [41–43], there may still be a place for this procedure in the very few cases with extensive circumferential lesions.

Conclusions

We found that TEM is a safe procedure, having a low recurrence rate and an acceptable functional outcome. We believe that TEM is the procedure of choice for benign lesions and also for T1 carcinoma in the middle and upper rectum due to the precise dissection and excellent exposure [2,5].

Acknowledgements

References

1 Buess G, Hutterer F, Theiss R, Böbel W, Isselhard W, Pichlmaier H. Das System für die transanale, endoskopische Rektumoperation. *Chir* 1984; **55:** 677–80.

2 Buess G. Review: transanal endoscopic microsurgery (TEM). *J Roy Coll Surg Edinb* 1993; **38:** 239–45.

3 Heintz A, Mörschel M, Junginger T. Comparison of results after transanal endoscopic microsurgery and radical resection for T1 carcinoma of the rectum. *Surg Endosc* 1998; **12:** 1145–8.

4 Lezoche E, Guerrieri M, Paganini AM, Feliciotti F. Transanal endoscopic microsurgical excision of irradiated and nonirradiated rectal cancer. A 5-year experience. *Surg Laparosc Endosc* 1998; **8:** 249–56.

5 Saclarides TJ. Transanal endoscopic microsurgery: a single surgeon's experience. *Arch Surg* 1998; **133:** 598–9.

6 Batignani G, Monaci I, Ficari F, Tonelli F. What affects continence after anterior resection of the rectum. *Dis Colon Rectum* 1991; **34:** 329–35.

7 Horgan PG, O'Connell PR, Shinkwin CA, Kirwan WO. Effect of anterior resection on anal sphincter function. *Br J Surg* 1989; **76:** 783–6.

8 Molloy RG, Moran KT, Coulter J, Waldron R, Kirwan WO. Mechanism of sphincter impairment following low anterior resection. *Dis Colon Rectum* 1992; **35:** 462–4.

9 O'Riordain MG, Molloy RG, Gillen P, Horgan A, Kirwan WO. Rectoanal inhibitory reflex following low stapled anterior resection of the rectum. *Dis Colon Rectum* 1992; **35:** 874–8.

10 Pedersen IK, Hint K, Olsen J, Christianse J, Jensen P, Mortensen P. Anorectal function after low anterior resection for carcinoma. *Ann Surg* 1986; **204:** 133–5.

11 Nakahara S, Itoh H, Mibu R *et al*. Clinical and mano-metric evaluation of anorectal function following low anterior resection with low anastomotic line using an EEA^tm stapler for rectal cancer. *Dis Colon Rectum* 1988; **31:** 762–6.

12 Graf W, Glimelius B, Bergström R, Påhlman L. Complications after double and single stapling in rectal surgery. *Eur J Surg* 1991; **157:** 543–7.

13 Österberg A, Graf W, Karlbom U, Påhlman L. Evaluation of a questionnaire in the assessment of patients with faecal incontinence and constipation. *Scand J Gastroenterol* 1996; **31:** 575–80.

14 Vaizey CJ, Carapeti E, Cahill JA, Kamm MA. Prospective comparison of faecal incontinence grading systems. *Gut* 1999; **44:** 77–80.

15 York Mason A. Surgical access to the rectum – a trans-sphincteric exposure. *Proc R Soc Med* 1970; **63** (Suppl.)**:** 91–4.

16 Lloyd GM, Sutton CD, Marshall LJ, Baragwanath P, Jameson JS, Scott AD. Transanal endoscopic microsurgery – lessons from a single UK centre series. *Colorectal Dis* 2002; **4:** 467–672.

17 Mörschel M, Heintz A, Bussmann M, Junginger T. Follow-up after transanal endoscopic microsurgery or transanal excision of large benign rectal polyps. *Langenbecks Arch Surg* 1998; **383:** 320–4.

18 Lev-Chelouche D, Margel D, Goldman G, Rabau MJ. Transanal endoscopic microsurgery: experience with 75 rectal neoplasms. *Dis Colon Rectum* 2000; **43:** 662–8.

19 Swanstrom LL, Smiley P, Zelko J, Cagle L. Video endo-scopic transanal-rectal tumor excision. *Am J Surg* 1997; **173:** 383–5.

20 Arribas del Amo D, Ramirez Rodriguez JM, Aguiella Diago V, Elia Gueda M, Palacios Fanlo MJ, Martinez Diez M. Transanal endoscopic surgery for rectal tumors. *Rev Esp Enferm Dig* 2000; **92:** 526–35.

21 Doornebosch PG, Tetteroo GW, Geldof H, de Graaf EJ. Transanal endoscopic microsurgery: a good choice for local resection of rectal tumors. *Ned Tijdschr Geneeskd* 1998; **21:** 2577–81. (in Dutch).

22 Spalinger R, Schlumpf R, Largiader F. Transanal endoscopic microsurgery – experiences at the Zurich University Hospital. *Schweiz Rundsch Med Prax* 1998; **87:** 1014–8 (in German).

23 Smith LE, Ko ST, Saclarides T, Caushaj P, Orkin BA, Khanduja KS. Transanal endoscopic microsurgery. Initial registry results. *Dis Colon Rectum* 1996; **39** (Suppl. 10)**:** S79–84.

24 Lezoche E, Guerrieri M, Paganini A, Feliciotti F, Di Pietrantonj F. Is transanal microsurgery (TEM) a valid treatment for rectal tumors? *Surg Endosc* 1996; **10:** 736–41.

25 Stipa S, Lucandri G, Stipa F, Chiavellati L, Sapienza P. Local excision of rectal tumours with transanal endoscopic micro-surgery. *Tumori* 1995; **81** (Suppl. 3)**:** 50–6.

26 Lirici MM, Chiavellati L, Lezoche E *et al*. Transanal endo-scopic microsurgery in Italy. *Endosc Surg Allied Technol* 1994; **2:** 255–8.

27 Winburn GB. Surgical resection of villous adenomas of the rectum. *Am Surg* 1998; **64:** 1170–3.

28 Sakamoto GD, MacKeigan JM, Senagore AJ. Transanal excision of large, rectal villous adenomas. *Dis Colon Rectum* 1991; **34:** 880–5.

29 Tjandra JJ, Cuthbertson AM, Penfold C. Sessile adenomas of the rectum: a personal series 1974–84. *Aust N Z J Surg* 1990; **60:** 883–6.

30 Heintz A, Braunstein S, Menke H. Local excision of rectal tumors. Indications, preoperative diagnosis, surgical tech-nique and results. *Med Klin* 1992; **87:** 236–41. (in German).

31 Calvo F, De Giuli M, Sandrucci S, Mussa A. Villous adenoma of the rectum. Review of the literature and personal experience. *G Chir* 1990; **11:** 37–43. (in Italian).

32 Mentges B, Buess G, Effinger G, Manncke K, Becker HD. Indications and results of local treatment of rectal cancer. *Br J Surg* 1997; **84:** 348–51.

33 Winde G, Nottberg H, Keller R, Schmid KW, Bunte H. Surgical cure for early rectal carcinomas (T1). Transanal endoscopic microsurgery vs. anterior resection. *Dis Colon Rectum* 1996; **39:** 969–76.

34 Lee W, Lee D, Choi S, Chun H. Transanal endoscopic microsurgery and radical surgery for T1 and T2 rectal cancer. *Surg Endosc* 2003; **17:** 1283–7.

35 Wang HS, Lin JK, Yang SH, Jiang JK, Chen WS, Lin TC. Prospective study of the functional results of transanal endoscopic microsurgery. *Hepatogastroenterology* 2003; **50:** 1376–80.

36 Herman RM, Richter P, Walega P, Popiela T. Anorectal sphincter function and rectal barostat study in patients following transanal endoscopic microsurgery. *Int J Colorectal Dis* 2001; **16:** 370–6.

37 Kreis ME, Jehle EC, Haug V *et al*. Functional results after transanal endoscopic microsurgery. *Dis Colon Rectum* 1996; **39:** 1116–21.

38 van Tets WF, Kuijpers JH, Tran K, Mollen R, van Goor H. Influence of Parks' anal retractor on anal sphincter pressures. *Dis Colon Rectum* 1997; **40:** 1042–5.

39 Kennedy ML, Lubowski DZ, King DW. Transanal endo-scopic microsurgery excision: is anorectal function compro-mised? *Dis Colon Rectum* 2002; **45:** 601–4.

40 Banerjee AK, Jehle EC, Kreis ME *et al*. Prospective study of the proctographic and functional consequences of transanal endoscopic microsurgery. *Br J Surg* 1996; **83:** 211–3.

41 Arnaud A, Fretes IR, Joly A, Sarles JC. Posterior approach to the rectum for treatment of selected benign lesions. *Int J Colorectal Dis* 1991; **6:** 100–2.

42 McCready DR, Ota DM, Rich TA, Thievoldt D, Jessup JM. Prospective phase I trial of conservative management of low rectal lesions. *Arch Surg* 1989; **124:** 67–70.

43 Klingensmith W, Dickinson WE, Hays RS. Posterior resection of selected rectal tumors. *Arch Surg* 1975; **110:** 647–51.