Transanal Approach to Rectal Polyps and Cancer

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Abstract

Keywords

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- rectal polyp

A transanal approach to rectal polyp and cancer excision is often an appropriate alternative to conventional rectal resection, and has a lower associated morbidity. There has been a steady evolution in the techniques of transanal surgery over the past 30 years. It started with traditional transanal excision and was revolutionized by introduction of transanal endoscopic microsurgery in early 1980s. Introduction of transanal minimally invasive surgery made it more accessible to surgeons around the world. Now robotic platforms are being tried in certain institutions. Concerns have been raised about recurrence rates of cancers with transanal approach and success of subsequent salvage operations.

In recent years, advanced endoscopic techniques such as endoscopic mucosal resection and endoscopic submucosal resection have decreased the role of invasive surgery in the treatment of premalignant colorectal disease. However, despite the most advanced medical and endoscopic therapies, colorectal polyps still often require surgical resection.

Choosing the appropriate surgical approach to complex rectal polyps and early rectal cancers is extremely important. This approach must often balance the rates of successful tumor eradication with the pain, disability, and functional implications to the patient. Due to the significant morbidity and alterations in quality of life associated with low anterior resection and abdominoperineal resection, a great deal of time and research has been dedicated to the transanal approach to these tumors.

The debate about patient selection for the transanal excision (TAE) of a rectal tumor has been extensive, and is often tailored to the patients based on their risk factors and their priorities. Such a discussion is beyond the scope of this article. Instead, we will focus on the general indications for local excision of rectal tumors, the available approaches and platforms, and the associated functional and oncologic outcomes.

Indications for Transanal Excision of Rectal Tumors

The local excision of rectal tumors has been long advocated for premalignant lesions, where all that is sought is tumor eradication, without need for lymph node sampling and without fear of leaving behind a residual invasive malignancy. TAE has also been used as definitive treatment of early rectal cancers in select groups without adverse prognostic features.¹ It has also been advocated as a palliative approach for advanced rectal cancers, especially in patients not fit for invasive surgery.² Atypical rectal tumors such as carcinoid tumors and gastrointestinal stromal tumors are often approached via TAE as well.

Traditional Transanal Excision

TAE utilizing conventional instruments and direct visualization has been the mainstay of treatment for many years. Standard TAE is often limited to tumors of less than 4 cm in diameter that lie within 6 to 8 cm of the anal verge.¹ The lesions located in middle and upper rectum are usually inaccessible with this technique because of their distance from the anal verge, and attempted excisions suffer from inadequate surgical exposure, confinement of the operating field, and uncertainty of the surgical clearance margin achieved.³

Patient selection for conventional TAE is very important. In a recent review, patients with tumors located proximal to the first rectal valve, patients with malignant lesions with adverse prognostic histologic factors, >3 cm in size, depth > T1, and patients with deep gluteal clefts were not considered as candidates for TAE.⁴

Patients should undergo preoperative assessment including digital exam and rigid proctoscopy to confirm location and mobility. Suspicious lesions should also undergo transrectal ultrasound and/or magnetic resonance imaging for staging. Patients receive a cleansing enema the day before the procedure. Positioning of the patient is left to the preference of the operating surgeon, but orientation of the lesion is usually the deciding factor, with preference taken to operating downward. Standard retractors such as Hill-Ferguson or Parks retractors are used to expose the lesion. Traction sutures can be placed distal to the lesion to improve mobility and visualization. The chosen excision margin is typically marked out with electrocautery in a circumferential pattern around the lesion. For tumors that harbor malignant potential, a 1-cm margin is typically employed. After full-thickness excision is done, the specimen is oriented on a needle board and sent to pathology. After irrigation, the defect can be either left open or closed transversely with absorbable sutures.

Complications associated with conventional TAE include urinary retention, urinary tract infection, delayed hemorrhage, infections of the perirectal and ischiorectal space, and fecal impactions.⁵

Limitations of Conventional Transanal Excision

Conventional TAE has several limitations. In general, TAE is limited to the distal rectum, with higher tumors being out of reach for this approach. Even more important is that visualization during TAE can be suboptimal, which can affect the quality of an oncologic resection. Concerns have also been raised about high rate of tumor fragmentation and high rates of tumor recurrence with traditional TAE. The high rates of recurrence are likely due to rates of margin positivity that exceed 10% in even the most experienced and expert case series.^{6,7}

However, there are some series with good results as well. In one study comprising 50 large rectal villous adenomas excised via traditional TAE, only one local recurrence was noted.⁸ The authors in this series attribute their low recurrence rate to avoiding preoperative biopsies to prevent the risk of tumor implantation, complete excision with clear circumferential and deep margins, a thorough Betadine washout to prevent tumor cell implantation, and nonclosure of the mucosal defect, thus avoiding needle implantation. Recurrences in up to 36% and significant complications in up to 19% of patients have been described in previous series of similar lesions.⁸

Transanal Endoscopic Microsurgery

Professor Gerhard Buess of Germany pioneered transanal endoscopic microsurgery (TEM) in the early 1980s as a minimally invasive technique allowing the resection of ade-

nomas and early rectal carcinomas unsuitable for local or colonoscopy excision, which would otherwise require major surgery⁹ (►Fig. 1). While it did not become immediately widespread, it gained significant momentum over the years, and developed increasing enthusiasm within the Western world.¹

The main indications for TEM are rectal tumors that are out of reach for conventional TAE and are unsuitable for endoscopic removal.¹⁰ This approach is useful for lesions in middle and upper rectum, and can even be extended to lesions in the low sigmoid colon, with success reported up to 20 cm from the anal verge.¹¹ Since its development, TEM has been also used for a variety of other rectal pathologies including carcinoid tumors, rectal prolapse, early stage carcinomas, and palliative resection of rectal cancers.¹²

The operative technique for TEM involves three main components: a rigid operating proctoscope, a laparoscopic camera, and modified laparoscopic instruments (►Fig. 1). The operating proctoscope is typically 4 cm in diameter and varies from 12 cm to 20 cm in length. The proctoscope maintains an airtight seal at the anus once inserted in the rectum and is held in place by the obligate articulating arm, which fixes the proctoscope to the operating table. The proctoscope has a port for the inflow of CO₂ for pneumorectum, and an outflow for smoke evacuation during cauterization. The faceplate on the proctoscope has four ports through which a camera and three modified laparoscopic instruments facilitate dissection and suturing.¹²

While the instruments are specialized, the operative steps are otherwise no different than for conventional TAE. After partial- or full-thickness excision of the rectal tumor, the surgical wound can be left open, or closed with a running or interrupted suture. Suturing with laparoscopic instruments within a rigid, narrow proctoscope can be quite cumbersome, so many tricks and tips have been recommended, including the use of surgical clips or metal beads to secure sutures instead of conventional laparoscopic knot-tying.¹

Benign lesions incompletely resected should be managed by early re-TEM. Recurrent polyps can also be managed by re-TEM and adenomas with high-grade dysplasia should be closely followed up.¹⁰

Fig. 1 Transanal endoscopic microsurgery (from: Saclarides TJ. Transanal endoscopic microsurgery. *Oper Tech Gen Surg* 2005;7 (3):107).

Limitations of Transanal Endoscopic Microsurgery

One significant limitation of the TEM platform is that the equipment is designed to operate from the top-down, so the lesion must be oriented toward the floor to be compatible with the equipment. This means that the patient's positioning is dependent on the tumor location, and sometimes specialized split-leg operating tables are necessary to resect anterior tumors requiring the prone position.

Other limitations to TEM focus on the specialized equipment, which has a steep learning curve and high associated costs to the hospital. These costs include the initial purchase of the TEM platform and any other specialized instruments and tables, as well as the ongoing costs of specialized disposable equipment needed for the TEM insufflation.^{13,14}

Outcomes of Transanal Endoscopic Microsurgery

TEM excision of adenomas results in low adenoma recurrence rates. In a review of 2,893 TEM procedures for adenomas, the reported local recurrence rates vary from 2 to 16%.¹² In a meta-analysis comparing standard TAE versus TEM, TEM had a higher rate of negative microscopic margins (odds ratio [OR], 5.281; 95% CI, 3.201–8.712; $p < 0.001$), a lower rate of specimen fragmentation (OR, 0.096; 95% CI, 0.044–0.209; $p < 0.001$), and lower rates of lesion recurrence (OR, 0.248; 95% CI, 0.154–0.401; $p < 0.001$) when compared with conventional TAE.¹⁵ Overall, TEM appears to be safe and effective for the treatment of rectal adenoma with better results than the conventional transanal approach.

When considering TEM for rectal cancer, the same principles apply to that of conventional TAE. In general, TEM for rectal cancer should be reserved for early lesions with favorable characteristics, or for patients with advanced cancers who are not suitable for invasive surgery due to comorbidities, and/or absolutely refuse fecal diversion. Cancer-related outcomes after TEM are discussed later in this article.

Complications of Transanal Endoscopic Microsurgery

The complication rate of TEM ranges from 3.4 to 10%,^{10,12} and mostly consists of minor complications including fever, urinary retention, rectal bleeding, and pain. Rare complications such as abdominal perforation, transitory fecal incontinence, suture dehiscence with pelvic abscess, and rectovaginal/rectovesical fistula have been reported. Few deaths have been reported in the literature. The conversion rate to conventional TAE is around 5%, and the main reason for conversion is technical difficulties.^{10,12}

Functional Outcomes after Transanal Endoscopic Microsurgery

TEM involves inserting a rigid proctoscope with a diameter of 40 mm, and concerns have been raised about its impact on

continence. Cataldo et al addressed this concern in 2005, looking at the ability to defer defecation, number of bowel movements per 24 hours, Fecal Incontinence Severity Index, and Fecal Incontinence Quality of Life survey. They found that TEM did not have significantly deleterious effect on fecal continence.¹⁶ In another study by Morino et al, it was observed that postprocedure anal resting pressure decreased temporarily, but returned to preoperative values at a mean of 4 months after surgery. No differences in maximum squeeze pressure or duration of voluntary contraction were noted.¹⁷

Transanal Minimally Invasive Surgery

As previously mentioned, some surgeons felt that the cost, positioning, specialized equipment, and steep learning curve associated with TEM limited utilization. In 2009, transanal minimally invasive surgery (TAMIS) was developed by Drs. Atallah, Albert, and Larach as an alternative to TEM.¹⁸ This technique utilizes a single, disposable, multichannel port inserted into the anus as opposed to the rigid operating proctoscope. When first conceived, the authors relied on ports designed for single-incision laparoscopic abdominal surgery, but since then, a port specialized for anorectal surgery has been developed.¹⁹ Conventional laparoscopic instruments, including a laparoscopic camera, graspers, and energy sources, along with a standard laparoscopic CO₂ insufflator are used for TAMIS.

In general, the steps to TAMIS are similar to TEM. However, there is more flexibility in patient positioning, as TAMIS allows the surgeon to operate in all quadrants of the rectum, without confinement to the top-down approach. After the patient is positioned, and the port is placed, pneumorectum is achieved with the conventional CO₂ insufflator, with pressures ranging from 15 to 25 mm Hg. Several different cameras can be employed, including those with a flexible tip. One common practice is to use the 5-mm, 30-degree bariatric camera with a right-angle light cord adaptor, as this limits external instrument collisions. Conventional graspers, scissors, and electrocautery devices are employed, along with ultrasonic or bipolar energy devices as needed. After tumor excision, the wound can be left open, or closed transversely with a variety of instruments. Due to the technical challenges of suturing in this confined space, many techniques similar to TEM have been employed, including the use of clips and beads, barbed suture, and specialized suturing devices such as the Endostitch (TM, Covidien).

Outcomes of Transanal Minimally Invasive Surgery

While TAMIS is promising, and has some potential advantages to TEM, it is newer, and the literature in support of TAMIS is therefore less robust. In particular, the follow-up after TAMIS is not long enough to completely assess tumor recurrence rates. Martin-Perez et al performed a systemic review of TAMIS in 2014, looking at over 35 publications, and finding 16 high-quality case series to review.¹⁹ They reported that the overall margin positivity rate for TAMIS was 4.36% (12/275),

with a tumor fragmentation rate of 4.1%. The mean operative time was 76 minute, with a range between 25 minute and 162 minute. Blood loss reported in most series was minimal. Only 9 of 390 excisions (2.31%) could not be completed with TAMIS and required conversion to TAE, TEM, or a laparoscopic abdominal approach.¹⁹

Complications of Transanal Minimally Invasive Surgery

The overall complication rate reported in the systematic review was 7.4%.¹⁹ Reported complications include urinary tract infection, *Clostridium difficile* diarrhea, rectal bleeding, rectal suture line dehiscence, and rectal stenosis.¹³ Inadvertent peritoneal entry during excision of proximal lesions has been described and closure has been achieved either with TAMIS suture closure or with laparoscopic assistance.¹⁹

Robotic Transanal Minimally Invasive Surgery

The same authors that introduced TAMIS went on to describe the use of a robotic platform for TAMIS in a cadaveric model in 2011,²⁰ and then extended that robotic TAMIS platform to live patients in 2012.²¹ Since then, it has been described in humans using both the GelPOINT Path platform (Applied Medical, Inc.)²² and a glove port (►Fig. 2).²³

The use of a glove as the multiport platform for transanal surgery was first described by two separate institutions in 2012,^{24,25} and was subsequently applied to robotic TAMIS in a series of 16 patients.²³ Here, the authors suggested that the transanal glove port facilitated the robotic setup, enabling flexibility and as such allowed docking of the cannulas away

from the limited perianal workspace.²³ Furthermore, the glove port allowed a wider axis of movement for instruments inside the rectum, enabling them to be used more widely apart, or easily rotated and/or crossed.

While robotic TAMIS has been shown to be feasible, this technique is still relatively new, and more studies are necessary prior to widespread adoption. Currently, several platforms exist for transanal access, each with its own associated benefits and detriments (►Table 1).¹³

Transanal Endoscopic Microsurgery, Transanal Minimally Invasive Surgery, and Rectal Cancer

Patient selection is critical while choosing a transanal approach to rectal cancer, regardless of chosen platform. The available evidence suggests that TEM alone seems to be a reasonable alternative to radical resection in patients with low-risk T1 adenocarcinomas. However, further therapeutic steps (salvage surgery or chemoradiation) should be considered in patients with positive margins.¹² In other high-risk cases with greater submucosal invasion (sm3), an sm2 sessile tumor, or with lymphovascular invasion, radical resection or adjuvant therapy after local resection should be considered.¹²

Based on the current evidence, experts suggest that TEM today is an appropriate definitive approach to malignant neoplasms that are histologically confirmed as pT1 sm1 carcinomas, with the use of TEM for T1 sm2–3 and T2 lesions limited to ongoing prospective trials.¹⁷ Therefore, accurate preoperative staging is essential for optimal selection of patients. Well-known negative prognostic factors are the diameter of the lesion > 3 cm, advanced pT staging, depth of submucosal invasion for pT1 cancers, poorly differentiated

Fig. 2 Robotic transanal minimally invasive surgery (from: Hompes R, Rauh SM, Ris F, Tuynman JB, Mortensen NJ. Robotic transanal minimally invasive surgery for local excision of rectal neoplasms. Br J Surg 2014;101(5):579).

Table 1 Transanal access devices for the endoluminal resection of rectal lesions

Technique (acronym)	Platform	Platform length (cm)	Proximal reach (cm)	Transanal access	Intraluminal rectal retraction	Company	Approximate cost (single use)
Transanal excision (TAE)	Anoscope, rectal retractor	3–5	8–10	Yes	No	N/A	N/A
Transanal endoscopic microsurgery (TEM)	TEM	15 and 20	15–20	Yes	Yes	Richard Wolf	\$80,000
Transanal endoscopic operation (TEO)	TEO	7.5, 15, and 20	7.5–15	Yes	Yes	Karl Storz Endoskope	\$30,000
Transanal minimally invasive surgery (TAMIS)	Single incision laparoscopic surgery	4	8–10	Yes	No	Covidien	\$500.00 (single use)
	GelPOINT Path	5	8–10	Yes	No	Applied Medical	\$800.00 (single use)
	GelPOINT Path Long Channel	15	15	Yes	Yes	Applied Medical	\$800.00 (single use)
	SSL			Yes	No	Ethicon Endosurgery	No longer available in the United States (single use)

Source: McLemore et al.¹³

tumor grading, positive resection margins, and the presence of lymphovascular infiltration.¹⁷

Salvage Surgery for Recurrences after Transanal Endoscopic Microsurgery

Local recurrence rates after TEM range from 0 to 33% for T1 rectal cancers and the results of salvage surgery for recurrent tumors represent a matter for concern. In a 2010 Dutch study concentrating on T1 lesions, 20.5% (18/88) of patients experienced local recurrence, with a median time to recurrence of 10 months.²⁶ In this series, salvage surgery for achieving local control was feasible in 83% of patients (15/18) without the need for multivisceral resection. However, 3-year overall and cancer-related survival were limited in this series (31 and 58%, respectively), mainly due to distant metastases. In another 2012 study from Rome, Italy, 96% (26/27) of patients with local recurrence after TEM underwent salvage surgery (repeat TEM in 9, and radical salvage surgery in 17). Of the 17 patients undergoing radical salvage surgery, 5-year survival was 69%, and the authors concluded that this outcome was comparable to overall survival after initial radical surgery.²⁷

Often, a local excision will be the primary approach to a polyp or known rectal cancer, but the subsequent final pathology warrants a low anterior resection or abdominoperineal resection. There is concern among surgeons that a full-thickness TAE, regardless of chosen approach, can impact the quality of the mesorectal excision if radical surgery is ultimately determined to be necessary. van Gijn et al looked at completion TME after TEM for unexpected cancer, and found that this resulted in more perma-

nent colostomies and higher local recurrence rates when compared with one-stage TME.²⁸ In contrast, Levic et al did not find any difference in outcome between patients with rectal cancer undergoing immediate salvage TME after TEM and those undergoing primary TME.²⁹ Despite their contrasting conclusions, both study groups warned that perforations into the original operating field during subsequent TME can occur due to fibrotic changes to the bowel wall which might allow microscopic tumor spill.

Transanal Total Mesorectal Excision

The latest development in transanal approach is transanal total mesorectal excision (taTME). This is a hybrid approach to low anterior resection in which the colon is mobilized laparoscopically, but the mesorectal excision is performed from the bottom using a TAMIS platform. The specimen is then extracted through the anus, and a hand-sewn coloanal anastomosis is performed. This technique is appealing in patients with low tumors and a narrow pelvis, as it has the potential to improve visibility while dissecting in the difficult pelvis.

In a recent series of 26 patients, the authors proved TaTME to be feasible and safe, and concluded that the transanal approach in patients with low rectal cancer seems to allow wider resection margins and higher rates of sphincter-saving procedures.³⁰ Another recent case series looked at 80 patients undergoing TaTME, and reported relatively good outcomes with a 88% rate of complete mesorectal intactness and a positive circumferential radial margin in 2.5% of patients (2/80).³¹ While TaTME is another new technique with great promise, supportive data are in its infancy, and further

studies with larger cohorts of patients are needed to evaluate long-term functional and oncological results.

Comparative Costs of Transanal Platforms

Several important factors have been discussed above when comparing different approaches to local excision of rectal tumors. Regarding TEM, one of the main complaints heard from surgeons and hospital administrators is that it is quite costly, not only as an initial investment, but also related to the ongoing expense associated with disposable accessories. ► **Table 1** provides a cost comparison between different platforms for transanal surgery.

Conclusion

There have been significant advances in the transanal approach to rectal polyps and rectal cancer in the last 30 years. There is a significant learning curve for the minimally invasive transanal techniques. Patient selection is the key to good outcomes. Greater sphincter salvage has been made possible by these techniques leading to a better quality of life. New techniques such as Robotic TAMIS and Transanal TME are unproven, and require long-term data to define their exact role in the surgical armamentarium. When treating patients with early rectal cancers, the risk of local recurrence must be balanced with quality of life. The surgeon should be familiar with the different treatment options, and present them in a way that the patient can make the ultimate decision regarding the best operative approach to their disease.

References

- Beck DE, Roberts PL, Saclarides TJ, et al. The ASCRS Textbook of Colon and Rectal Surgery. 2nd ed. New York: Springer Science and Business Media, LLC; 2011:731–741
- Kim CJ, Yeatman TJ, Coppola D, et al. Local excision of T2 and T3 rectal cancers after downstaging chemoradiation. *Ann Surg* 2001; 234(3):352–358, discussion 358–359
- Neary P, Makin GB, White TJ, et al. Transanal endoscopic microsurgery: a viable operative alternative in selected patients with rectal lesions. *Ann Surg Oncol* 2003;10(9):1106–1111
- Salehomoum NM, Noguera JJ. Conventional transanal excision: current status and role in the era of transanal endoscopic surgery. *Semin Colon Rectal Surg* 2015;26(1):6–8
- Bleday R, Garcia-Aguilar J. Surgical treatment of rectal cancer. In: Wolff BG, Fleshman JW, Beck DE, et al., eds. The ASCRS Textbook of Colon and Rectal Surgery. New York: Springer; 2007:425
- Paty PB, Nash GM, Baron P, et al. Long-term results of local excision for rectal cancer. *Ann Surg* 2002;236(4):522–529, discussion 529–530
- Garcia-Aguilar J, Mellgren A, Sirivongs P, Buie D, Madoff RD, Rothenberger DA. Local excision of rectal cancer without adjuvant therapy: a word of caution. *Ann Surg* 2000;231(3):345–351
- Featherstone JM, Grabham JA, Fozard JB. Per-anal excision of large, rectal, villous adenomas. *Dis Colon Rectum* 2004;47(1):86–89
- Buess G, Theiss R, Hutterer F, et al. Transanal endoscopic surgery of the rectum - testing a new method in animal experiments [in German]. *Leber Magen Darm* 1983;13(2):73–77
- Dias AR, Nahas CSR, Marques CFS, Nahas SC, Ceconello I. Transanal endoscopic microsurgery: indications, results and controversies. *Tech Coloproctol* 2009;13(2):105–111
- Nivatvongs S. Transanal techniques. In: Gordon PH, Nivatvongs S eds. Principles and Practice of Surgery for the Colon, Rectum and Anus. 3rd ed. New York: Informa Healthcare; 2007:399
- Heidary B, Phang TP, Raval MJ, Brown CJ. Transanal endoscopic microsurgery: a review. *Can J Surg* 2014;57(2):127–138
- McLemore EC, Weston LA, Coker AM, et al. Transanal minimally invasive surgery for benign and malignant rectal neoplasia. *Am J Surg* 2014;208(3):372–381
- Saclarides TJ. The history of transanal endoscopic surgery. *Semin Colon Rectal Surg* 2015;26(1):2–5
- Clancy C, Burke JP, Albert MR, O'Connell PR, Winter DC. Transanal endoscopic microsurgery versus standard transanal excision for the removal of rectal neoplasms: a systematic review and meta-analysis. *Dis Colon Rectum* 2015;58(2):254–261
- Cataldo PA, O'Brien S, Osler T. Transanal endoscopic microsurgery: a prospective evaluation of functional results. *Dis Colon Rectum* 2005;48(7):1366–1371
- Morino M, Arezzo A, Allaix ME. Transanal endoscopic microsurgery. *Tech Coloproctol* 2013;17(Suppl 1):S55–S61
- Atallah S, Albert M, Larach S. Transanal minimally invasive surgery: a giant leap forward. *Surg Endosc* 2010;24(9):2200–2205
- Martin-Perez B, Andrade-Ribeiro GD, Hunter L, Atallah S. A systematic review of transanal minimally invasive surgery (TAMIS) from 2010 to 2013. *Tech Coloproctol* 2014;18(9):775–788
- Atallah SB, Albert MR, deBeche-Adams TH, Larach SW. Robotic transanal minimally invasive surgery in a cadaveric model. *Tech Coloproctol* 2011;15(4):461–464
- Atallah S, Parra-Davila E, DeBeche-Adams T, Albert M, Larach S. Excision of a rectal neoplasm using robotic transanal surgery (RTS): a description of the technique. *Tech Coloproctol* 2012; 16(5):389–392
- Atallah S, Martin-Perez B, Parra-Davila E, et al. Robotic transanal surgery for local excision of rectal neoplasia, transanal total mesorectal excision, and repair of complex fistulae: clinical experience with the first 18 cases at a single institution. *Tech Coloproctol* 2015;19(7):401–410
- Hompes R, Rauh SM, Ris F, Tuynman JB, Mortensen NJ. Robotic transanal minimally invasive surgery for local excision of rectal neoplasms. *Br J Surg* 2014;101(5):578–581
- Alessandro C, Daniela M, Michele M, et al. Glove port technique for transanal endoscopic microsurgery. *Int J Surg Oncol* 2012; 2012:383025
- Hompes R, Ris F, Cunningham C, Mortensen NJ, Cahill RA. Transanal glove port is a safe and cost-effective alternative for transanal endoscopic microsurgery. *Br J Surg* 2012;99(10):1429–1435
- Doornebosch PG, Ferenschild FTJ, de Wilt JHW, Dawson I, Tetteroo GWM, de Graaf EJ. Treatment of recurrence after transanal endoscopic microsurgery (TEM) for T1 rectal cancer. *Dis Colon Rectum* 2010;53(9):1234–1239
- Stipa F, Giaccaglia V, Burza A. Management and outcome of local recurrence following transanal endoscopic microsurgery for rectal cancer. *Dis Colon Rectum* 2012;55(3):262–269
- van Gijn W, Brehm V, de Graaf E, et al. Unexpected rectal cancer after TEM: outcome of completion surgery compared with primary TME. *Eur J Surg Oncol* 2013;39(11):1225–1229
- Levic K, Bulut O, Hesselfeldt P, Bülow S. The outcome of rectal cancer after early salvage TME following TEM compared with primary TME: a case-matched study. *Tech Coloproctol* 2013; 17(4):397–403
- Muratore A, Mellano A, Marsanic P, De Simone M. Transanal total mesorectal excision (taTME) for cancer located in the lower rectum: short- and mid-term results. *Eur J Surg Oncol* 2015; 41(4):478–483
- Veltcamp Helbach M, Deijen CL, Velthuis S, Bonjer HJ, Tuynman JB, Sietses C. Transanal total mesorectal excision for rectal carcinoma: short-term outcomes and experience after 80 cases. *Surg Endosc* 2015 (e-pub ahead of print). DOI 10.1007/s00464-015-4221-y