


Functional complaints and quality of life after transanal total mesorectal excision: a meta-analysis

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Background: Total mesorectal excision (TME) gives excellent oncological results in rectal cancer treatment, but patients may experience functional problems. A novel approach to performing TME is by single-port transanal minimally invasive surgery. This systematic review evaluated the functional outcomes and quality of life after transanal and laparoscopic TME.

Methods: A comprehensive search in PubMed, the Cochrane Library, Embase and the trial registers was conducted in May 2019. PRISMA guidelines were used. Data for meta-analysis were pooled using a random-effects model.

Results: A total of 11 660 studies were identified, from which 14 studies and six conference abstracts involving 846 patients (599 transanal TME, 247 laparoscopic TME) were included. A substantial number of patients experienced functional problems consistent with low anterior resection syndrome (LARS). Meta-analysis found no significant difference in major LARS between the two approaches (risk ratio 1.13, 95 per cent c.i. 0.94 to 1.35; $P = 0.18$). However, major heterogeneity was present in the studies together with poor reporting of functional baseline assessment.

Conclusion: No differences in function were observed between transanal and laparoscopic TME.

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Introduction

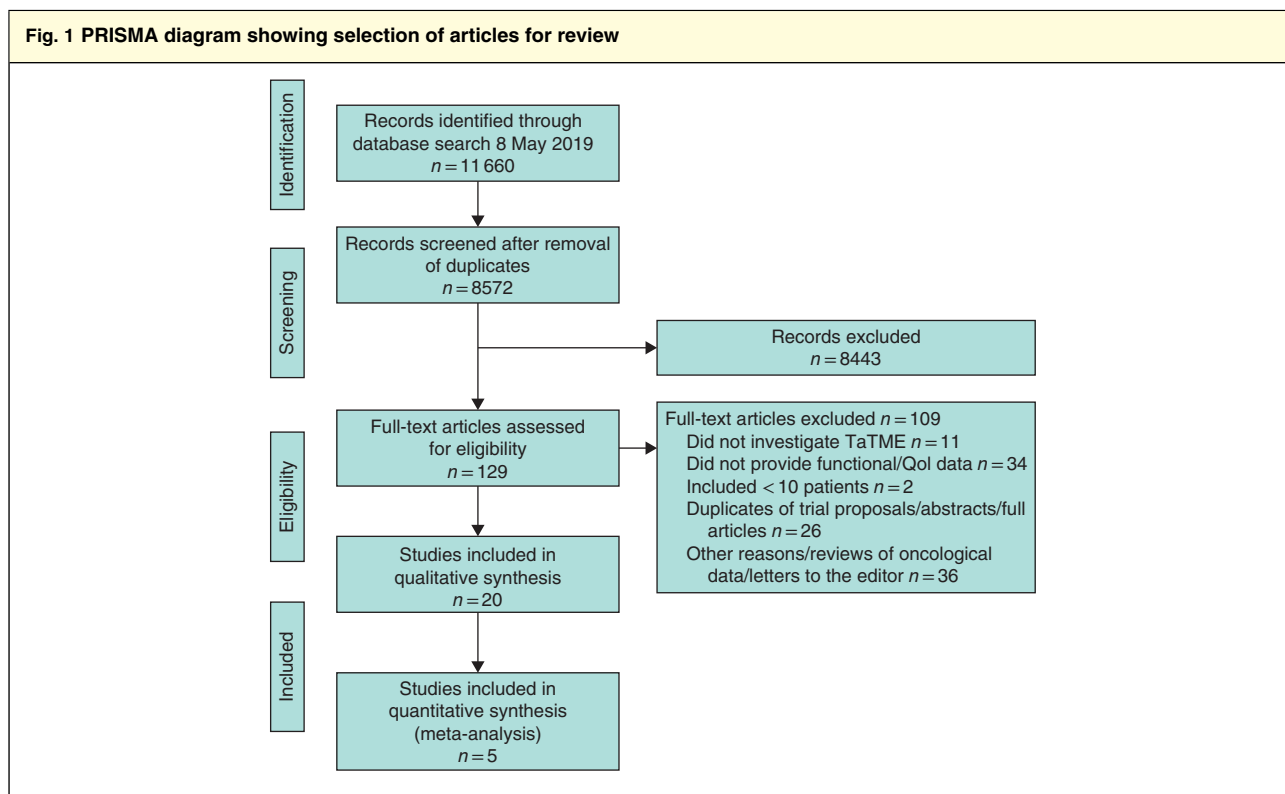
Total mesorectal excision (TME) is the standard surgical treatment for rectal cancer, with excellent long-term local recurrence-free and overall survival rates¹. Over time, advances in technology led to a shift from open to laparoscopic surgery owing to favourable short-term outcomes such as less pain, reduced blood loss and improved recovery time^{2–6}. However, quality of life (QoL) and functional outcomes were not significantly improved by the laparoscopic approach^{7,8}. The latest developments are the robotic and the transanal approach. The latter, called transanal TME (TaTME) has been developed to overcome surgical difficulties experienced during distal pelvic dissection, especially in men with a narrow pelvis, a low tumour and a high BMI⁹. Long-term results of randomized studies are awaited, especially since the Norwegian moratorium on TaTME owing to an unexpectedly high local recurrence rate¹⁰.

Although many studies have investigated functional bowel dysfunction after laparoscopic low anterior

resection^{11–13}, little is known about these functional sequelae after TaTME and their impact on QoL. The most common postoperative complaints, such as incontinence, urgency and frequent bowel movement, are described as low anterior resection syndrome (LARS). This syndrome has a severe adverse effect on QoL^{14–16}. Known risk factors for the development of LARS are a low level of anastomosis, poor preoperative function and neoadjuvant chemoradiotherapy^{17–20}. With the TaTME technique, surgeons might choose a lower anastomosis for technical rather than oncological reasons, and urethral injuries are more likely²¹. Concerns regarding functional outcomes after TaTME have been expressed. This meta-analysis was conducted to compare functional outcomes and QoL after TaTME and laparoscopic TME (LapTME).

Methods

This review was conducted in accordance with PRISMA guidelines^{22,23}, with an *a priori* developed review protocol (PROSPERO; CRD42019126975). A comprehensive



TaTME, transanal total mesorectal excision; QoL, quality of life.

search was undertaken in PubMed, Embase, the Cochrane database and the trial registers. The full search strategy is available in *Appendix S1* (supporting information).

Two reviewers performed the selection process and reviewed all included studies. Discrepancies were resolved through discussion. The following inclusion criteria were applied: patients with rectal cancer who underwent TaTME and received any assessment of functional outcome or QoL. If a study also included patients who underwent LapTME, this group was used as a comparator for the TaTME group. All study designs with a population of ten or more patients were included. No filters for language or date were used. Studies were excluded if they evidently contained the same data, or were letters to the editor or expert opinions. If reported, the time from ileostomy closure to the evaluation of functional outcome was included. Quality assessment was performed by using the Newcastle–Ottawa Scale for observational studies²⁴ and the Cochrane quality assessment tool for randomized trials²⁵.

Analysis

Basic descriptive statistics were used to summarize patient characteristics and outcome data. A meta-analysis was

performed if sufficient studies and adequate data were available. The Mantel–Haenszel method was used for dichotomous data. A random-effects model was used and checked using a fixed-effect model. If the requested data were not available, mean(s.d.) values were calculated for overall analysis, if possible²⁶. A meta-analysis of *P* values was performed in comparative studies of QoL data evaluated by the European Organization for Research and Treatment of Cancer (EORTC) questionnaires²⁷. The Cochrane handbook 6 was used as a guideline for this analysis²⁸. No funnel plots were presented, owing to the limited number of studies available for meta-analysis²⁸. Analyses were performed using Review Manager version 5.3.5 (Nordic Cochrane Centre, The Cochrane Collaboration, Copenhagen, Denmark), and Microsoft Excel® (Microsoft, Redmond, Washington, USA) for the meta-analysis that combined *P* values.

Results

Study selection

The search was performed in May 2019 and returned 11 660 articles after removal of duplicates from which

Table 1 Bowel dysfunction as measured by low anterior resection score

Reference	No. of patients	Duration of follow-up (months)	Total LARS score	No LARS	Minor LARS	Major LARS
Bjoern <i>et al.</i> ²⁹	49 TaTME	22.7 (10.3)*	26.2 (10.3)*	17 (35)	15 (31)	17 (35)
	36 LapTME	75.1 (17.6)*	20.6 (14.5)* (<i>P</i> = 0.054)	16 (44)	8 (22)	12 (33)
Veltcamp Helbach <i>et al.</i> ³⁰	27 TaTME	20.0 (6.6–44.4)†	27.7 (13.3)*	7 (26)	4 (15)	16 (59)
	27 LapTME	59.5 (39.7–82.0)†	24.0 (10.5)* (<i>P</i> = 0.267)	11 (41)	8 (30)	8 (30)
Turrado-Rodriguez <i>et al.</i> ³¹	80 TaTME	37.6‡	n.r.		31 (39)	49 (61)
Rubinkiewicz <i>et al.</i> ³²	25 TaTME	Baseline	5 (0–12)§	n.r.	n.r.	n.r.
		6	32 (30–37)§	0 (0)	4 (16)	21 (84)
Reali <i>et al.</i> ³³	29 TaTME	Baseline	n.r.	11 (38)	13 (45)	5 (17)
		24	n.r.	8 (28)	15 (52)	6 (21)
Mora <i>et al.</i> ³⁴	16 TaTME	6	n.r.	3 (19)	3 (19)	10 (63)
	15 LapTME	6	n.r.	4 (27)	2 (13)	9 (60)
Koedam <i>et al.</i> ³⁷	30 TaTME	Baseline	15.4 (7.3, 23.5)¶	16 (53)	10 (33)	4 (13)
		1	35.7 (32.9, 38.6)¶	0 (0)	6 (20)	24 (80)
		6	21.7 (13.6, 29.9)¶	14 (47)	6 (20)	10 (33)
Hanke <i>et al.</i> ³⁸	31 TaTME	3	25‡	n.r.	n.r.	n.r.
	17	6	21‡	n.r.	n.r.	n.r.
	13	9	18‡	n.r.	n.r.	n.r.
	10	12	10‡	n.r.	n.r.	n.r.
	7	18	10‡	n.r.	n.r.	n.r.
	4	24	2.5‡	n.r.	n.r.	n.r.
Pontallier <i>et al.</i> ⁴⁰	38 TaTME	>12	36 (12–42)†	n.r.	n.r.	31 (82)
	34 LapTME		37 (12–42)† (<i>P</i> = 0.977)	n.r.	n.r.	26 (76)
Kneist <i>et al.</i> ⁴¹	10 TaTME	Baseline	n.r.	9 (90)	1 (10)	0 (0)
		3	28 (9–38)†	3 (30)	3 (30)	4 (40)
		6	26 (9–32)†	4 (40)	5 (50)	1 (10)
Keller <i>et al.</i> ⁴⁴	61 TaTME	Baseline	23.0 (9.7)*	22 (40)	20 (36)	13 (24)
		12	25.6 (8.0)*	n.r.	n.r.	n.r.
Leão <i>et al.</i> ⁴⁶	20 TaTME	1	32.7#	(14)	(7)	(79)
		3	n.r.	(23)	(8)	(69)
		6	n.r.	(38)	(23)	(38)
		12	19.5#	(50)	(40)	(10)
Dou <i>et al.</i> ⁴⁷	54 TaTME	17.2 (12.1–30.4)†	n.r.	n.r.	n.r.	26 (48)
	53 LapTME		n.r.	n.r.	n.r.	22 (42)

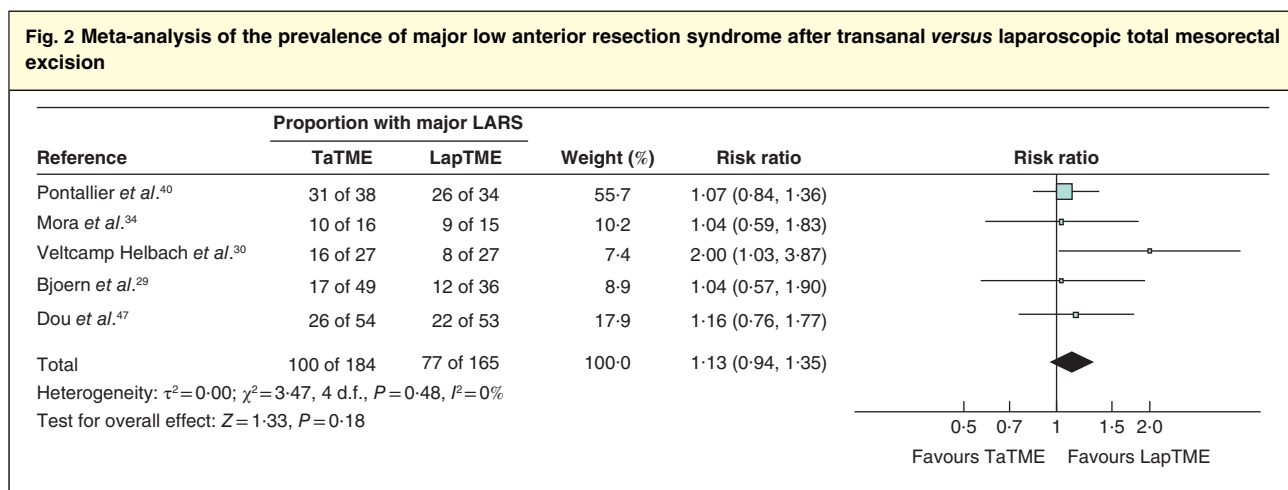
Values in parentheses are percentages unless indicated otherwise; values are *mean (s.d.), †median (range), ‡median, §median (i.q.r.), ¶mean (95 per cent c.i.) and #mean. LARS, low anterior resection syndrome; TaTME, transanal total mesorectal excision; LapTME, laparoscopic total mesorectal excision; n.r., not reported. *P* values are shown for TaTME *versus* LapTME.

left 8572 studies. After exclusion of irrelevant articles, 90 potentially relevant studies and 39 potentially relevant trials were assessed further. Eventually 14 studies and six conference abstracts were included (*Fig. 1*)^{9,29–47}. Studies were excluded for the following reasons: did not investigate TaTME (11), did not provide functional/QoL data (34), included fewer than ten patients (2) or other reasons (62).

Study characteristics and quality control

Six retrospective (3 cross-sectional, 2 cohort, 1 case-control) and 14 prospective (11 cohort, 2 cross-sectional,

1 RCT) studies were included (*Table S1*, supporting information). The studies included 599 patients who underwent TaTME. A total of 247 patients who underwent LapTME were identified as a control group to compare with patients who underwent TaTME. Duration of follow-up after surgery varied from 3 to 75 months. Seven studies included a baseline measurement in the study design. In the majority of studies, the tumour was located in the lower and middle rectum (tumour height 3.7–7.1 cm). Mean temporary ileostomy rates were 92.2 per cent in the TaTME group compared with 88.1 per cent in the LapTME group. Some 61.5 per cent of the



A Mantel–Haenszel random-effects model was used for meta-analysis. Risk ratios are shown with 95 per cent confidence intervals. The longest follow-up data for each study were used. If a study favours laparoscopic total mesorectal excision (LapTME), fewer patients experienced major low anterior resection syndrome (LARS) in this group. TaTME, transanal total mesorectal excision.

Table 2 Continence status as measured by Wexner score

Reference	No. of patients	Duration of follow-up (months)	Wexner score*	Wexner score > 10 (major incontinence)
Turrado-Rodriguez <i>et al.</i> ³¹	80 TaTME	37.6(17.7)†	10(5)†	n.r.
Rubinkiewicz <i>et al.</i> ³²	25 TaTME	Baseline	0 (0–2)	n.r.
		6	11 (8–12)	n.r.
Hanke <i>et al.</i> ³⁸	31 TaTME	3	9	n.r.
	17	6	6	n.r.
	13	9	4	n.r.
	10	12	2	n.r.
	7	18	4	n.r.
	4	24	0	n.r.
Elmore <i>et al.</i> ³⁹	12 TaTME	Baseline	n.r.	n.r.
		6	3 (1–8)	n.r.
Pontallier <i>et al.</i> ⁴⁰	38 TaTME	> 12	9 (2–20)	16 (42)
	34 LapTME		10 (3–20)	14 (41)
			($P=0.932$)	($P=0.936$)
Kneist <i>et al.</i> ⁴¹	10 TaTME	Baseline	1 (0–7)	0 (0)
		3	9 (1–20)	4 (40)
		6	7 (0–15)	3 (30)
Tuech <i>et al.</i> ⁴²	52 TEAP	> 12	4 (3–12)	7 (13)
				> 7 points
De'Angelis <i>et al.</i> ⁴³	32 TaTME	3	9 (3–15)	10 (32)
	32 LapTME	3	10.5 (4–19)	16 (50)
			($P=0.115$)	
Rouanet <i>et al.</i> ⁹	30 TEAP	12	11	n.r.
Keller <i>et al.</i> ⁴⁴	61 TaTME	Baseline	n.r.	n.r.
		12	n.r.	n.r.
Leão <i>et al.</i> ⁴⁶	20 TaTME	1	10.3	n.r.
	20	3	7.9	n.r.
	20	6	4.6	n.r.
	8	12	2.8	n.r.

Values in parentheses are percentages unless indicated otherwise; *values are median (range), except †mean(s.d.). TaTME, transanal total mesorectal excision; n.r., not reported; LapTME, laparoscopic total mesorectal excision; TEAP, transanal endoscopic proctectomy. P values are shown for TaTME versus LapTME.

patients received neoadjuvant treatment before TaTME compared with 70.8 per cent before LapTME. The height of anastomosis was not reported systematically, but was significantly lower after TaTME in the study of Mosquera and colleagues⁴⁵. Other comparative studies showed no relevant differences in tumour height or site (mid, low, high).

Four of the included studies were of high quality based on the Newcastle–Ottawa Scale, scoring at least 7 points (Table S2, supporting information). Overall quality was acceptable, except that baseline measurements were not frequently reported and relatively few studies presented a comparator LapTME group. The only RCT was of good quality, except for an unclear risk of selective reporting.

Bowel dysfunction

Thirteen studies assessed bowel dysfunction by measuring the LARS score (Table 1), and five compared LARS scores after TaTME *versus* LapTME. Meta-analysis showed no significant differences in the incidence of major LARS between the procedures (Fig. 2). Sensitivity analyses excluding studies with follow-up of less than 12 months (risk ratio (RR) 1.15, 95 per cent c.i. 0.93 to 1.43) and studies with significant differences in baseline characteristics between TaTME and LapTME groups (RR 1.08, 0.89 to 1.32) showed no differences in bowel dysfunction outcomes between procedures.

Bjoern and colleagues²⁹ reported no significant difference in LARS scores after TaTME compared with LapTME ($P = 0.054$) (Table 1). For the subcategories clustering of stools ($P = 0.017$) and faecal urgency ($P = 0.032$), a significant disadvantage for TaTME was found. Koedam and co-workers³⁷ reported significantly worse LARS scores 1 month after TaTME surgery, but did not note a significant difference at 6 months compared with baseline scores. A significant increase in LARS scores was demonstrated after surgery in all studies³³. However, these scores returned to baseline values in the majority of studies^{33,44,46}.

Continence

Eleven studies used the Wexner score to assess the level of continence (Table 2); two others^{36,44} used the Vaizey or Kirwin score. All studies that performed a preoperative assessment of function^{32,39,41} confirmed that no major preoperative deviations in Wexner score were present. Summarizing data that reported Wexner scores at specific times (3, 6, 9, 12, 18, 24 months) showed a median Wexner score at 3 months of 9 (range 1–20)^{38,41,43}. At 6 months, median scores ranged from 3 to 7^{38,41,43}. Rouanet *et al.*⁹

recorded a median Wexner score of 11 after 12 months. Tuech and colleagues⁴² reported that three of 52 patients received a colostomy owing to faecal incontinence after a minimum of 12 months of conservative therapy. Three studies^{40,43,45} compared TaTME with LapTME and none of them reported significant differences.

Urogenital dysfunction

The International Index of Erectile Function (IIEF/IIEF-5), International Prostate Symptom Score (IPPS) and Female Sexual Function Index (FSFI) were used to evaluate urogenital dysfunction after TaTME (Table 3).

Urogenital function in men

Foo and colleagues³⁵ noted that erectile function in 23 men worsened significantly after surgery ($P = 0.002$) but returned to baseline after 6 months ($P = 0.142$). Pontallier and co-workers⁴⁰ did not find any significant differences in IIEF scores ($P = 0.119$) or category of erectile dysfunction (IIEF 21 or less; $P = 0.108$). Regarding urological function, Foo *et al.*³⁵ showed no significant differences in scores measured at baseline, and 3 and 6 months after surgery. In studies that compared TaTME with LapTME^{29,30,40}, there were no significant difference in IPPS scores between procedures (Table 3). Bjoern and co-workers²⁹ reported a significant effect on the IPPS QoL score in favour of TaTME ($P = 0.01$).

Urogenital function in women

Pontallier and colleagues⁴⁰ reported sexual dysfunction in two of five women after TaTME and in two of three in the LapTME group. Turrado-Rodriguez and co-workers³¹ reported sexual dysfunction in 17 of 26 women after TaTME and concluded that these outcomes were similar to those of LapTME.

Quality-of-life assessment

Four different QoL questionnaires were used, namely the EuroQol Five Dimensions (EQ-5D™; EuroQol Group, Rotterdam, the Netherlands), EORTC QLQ-C30, QLQ-CR29 and Faecal Incontinence Quality of Life scale (FIQL) questionnaire. The QLQ-CR38 is also frequently used for colorectal cancer, but not in the studies included in the present review. EQ-5D™ data are known to correlate weakly with changes in defaecation pattern⁴⁸, and are shown in Table S3 (supporting information).

Faecal Incontinence Quality of Life scale

Only one study⁴⁶ included the FIQL, and reported baseline scores of 4.0 (lifestyle, coping/behaviour, embarrassment) and 4.4 (depression/self-perception). A decrease in

Table 3 Urogenital dysfunction as measured by International Index of Erectile Function and International Prostate Symptom Score

Reference	No. of patients	Duration of follow-up (months)	IIEF score	Patients with erectile dysfunction (IIEF score ≤ 21)	IPSS	IPSS quality-of-life score	IPSS category
Bjoern <i>et al.</i> ²⁹	37 TaTME	22.7(10.3)*	n.r.	n.r.	6.7(7.4)*	Score 1/2/3/4/5/6/7: 22/7/7/0/0/1/0	No: 6 (16) Mild: 17 (46) Moderate: 12 (32) Severe: 2 (5)
	20 LapTME	75.1(17.6)*	n.r.	n.r.	10.1(8.2)* (<i>P</i> = 0.060)	Score 1/2/3/4/5/6/7: 8/7/0/3/1/0/1 (<i>P</i> = 0.01)	No: 1 (5) Mild: 9 (45) Moderate: 8 (40) Severe: 2 (10) (<i>P</i> = 0.236)
Veltcamp Helbach <i>et al.</i> ³⁰	14 TaTME	20.0 (6.6–44.4)†	n.r.	n.r.	8(6.6)*	n.r.	No/mild: 7 (50) Moderate: 7 (50) Severe: 0 (0)
	18 LapTME	59.5 (39.7–82.0)†	n.r.	n.r.	6.7(6.3)* (<i>P</i> = 0.582)	n.r.	No/mild: 12 (67) Moderate: 5 (28) Severe: 1 (6) (<i>P</i> = 0.277)
Pontallier <i>et al.</i> ⁴⁰	21 TaTME	38 (15–39)† Functional assessment > 12	17.5 (5–25)†	14 (67)	5.5 (0–23)†	1 (0–6)†	IPSS >10: 21%
	16 LapTME		7 (5–21)† (<i>P</i> = 0.119)	15 (93) (<i>P</i> = 0.108)	3.5 (0–27)† (<i>P</i> = 0.821)	1 (0–5)† (<i>P</i> = 0.967)	IPSS >10: 21% (<i>P</i> = 0.961)
Kneist <i>et al.</i> ⁴¹	10 TaTME						
	9	Baseline	n.r.	n.r.	5 (0–31)†	1 (0–4)	No/mild: 6 (67) Moderate: 2 (22) Severe 1 (11)
	9	3	n.r.	n.r.	3 (1–20)†	n.r.	No/mild: 7 (78) Moderate: 1 (11) Severe: 1 (11)
	9	6	n.r.	n.r.	n.r.	n.r.	No/mild: 7 (78) Moderate: 1 (11) Severe: 1 (11)
	6	9	n.r.	n.r.	n.r.	n.r.	No/mild: 5 (83) Moderate: 1 (17) Severe: 0 (0)
Keller <i>et al.</i> ⁴⁴	TaTME 61						
	50	Baseline	19.3(5.9)*	n.r.	6.3(5.0)*	1.3(1.4)	n.r.
	50	12	17.6(6.4)*	n.r.	5.9(4.7)*	1.4(1.2)	n.r.

Values in parentheses are percentages unless indicated otherwise; values are *mean(s.d.) and †median (range). The International Prostate Symptom Score (IPSS) ranges from 0 to 35, with categories no/mild (0–7), moderate (8–19) and severe (20–35) complaints. IIEF, International Index of Erectile Function; TaTME, transanal total mesorectal excision; n.r., not reported/not reported correctly; LapTME, laparoscopic total mesorectal excision. *P* values are shown for TaTME *versus* LapTME.

QoL scores was seen 1 and 3 months after surgery (lifestyle 2.1–2.4, coping 2.5–3.5, depression 2.2–2.5, embarrassment 2.0–3.2), but scores returned to baseline within 1 year after TaTME (lifestyle 3.8, other scores 3.9).

EORTC QLQ-C30

Two studies presented QoL scores over time (Table S4, supporting information). Keller and colleagues⁴⁴ reported that emotional function increased significantly after 1 year compared with preoperative measurements (*P* ≤ 0.01). Koedam and co-workers³⁷ described a significant decrease in QoL (*P* = 0.012), physical functioning (*P* = 0.001),

role functioning (*P* = 0.001), fatigue (*P* = 0.002) and general pain (*P* = 0.001). After 6 months, these effects disappeared, except for social functioning (*P* = 0.013) and anal pain (*P* = 0.013), which remained significantly worse than at baseline.

Three studies^{29,30,34} compared TaTME with LapTME. Veltcamp Helbach and colleagues³⁰ reported scores for role functioning (89.5 *versus* 80.2; *P* = 0.042), fatigue (12 *versus* 26.5; *P* = 0.021) and faecal incontinence (2.4 *versus* 14.8; *P* = 0.032) in favour of LapTME. A discrepancy between studies was found for the domain emotional functioning; scores favouring LapTME were reported by

Bjoern *et al.*²⁹ (83.51 *versus* 87.07; $P=0.041$), whereas Mora and colleagues³⁴ described better scores for TaTME (89.58 *versus* 77.38; $P=0.031$). Functional scores for diarrhoea were in favour of LapTME in the study of Bjoern and co-workers²⁹ (17.69 *versus* 4.62; $P=0.009$). In a meta-analysis combining significance levels, no statistically significant differences were found between QoL subdomains for the comparative studies (Table S4, supporting information).

EORTC QLQ-CR29

Buttock pain ($P=0.01$) and faecal incontinence ($P=0.03$) were significantly worse in the TaTME group^{29,30}. Scores on all other scales were comparable, including flatulence and sexual function. Mora *et al.*³⁴ described more abdominal pain and a bloated feeling in the LapTME group. A meta-analysis combining significance levels showed no significant differences between the QoL subdomains for the comparative studies (Table S4, supporting information).

Discussion

The present review investigated the impact of TaTME on functional outcomes and QoL. A significant proportion of patients who underwent TaTME experienced impaired postoperative bowel function. These complaints appeared to be present equally in patients treated by transanal and laparoscopic approaches.

A potential advantage of TaTME is that it allows construction of a (low) anastomosis in patients in whom abdominoperineal resection would previously have been necessary³². However, since the introduction of TaTME, concerns have been raised about postoperative function and QoL owing to factors such as the low anastomosis, urethral injuries, insertion of the transanal platform and anal stretch^{21,49}. Anal stretch and dilatation carries a potential risk of damaging the sphincter complex during transanal surgery. Previous studies of transanal endoscopic microsurgery (TEM) showed that controlled anal dilatation caused significant decreases in resting and voluntary contraction pressures, but had no influence on Wexner scores indicating clinical incontinence⁵⁰, or long-term QoL after TEM⁵¹.

To the extent that the included studies allow, given their follow-up and quality, TaTME appears to be similar to LapTME in terms of functional outcomes. Potential risk factors for functional outcomes after TaTME were not investigated in this review. In a meta-analysis regarding major LARS, no significant differences were found between LapTME and TaTME (RR 1.13, 95 per cent c.i. 0.94 to 1.35). In several non-comparative studies that

analysed TaTME only, variations in outcomes were found that could be explained by patient characteristics. In the study of Bjoern and colleagues²⁹, scores for the subcategories clustering of stools and faecal urgency reached statistical significance not in favour of TaTME, but it is important to note that this study failed to report several important patient characteristics (such as preoperative function) and showed a significant difference in the timing of questionnaires. Although LARS scores were impaired after TaTME, only a few patients were reported who underwent complete disconnection of the anastomosis and construction of colostomy owing to faecal incontinence⁴². Male erectile function worsened after surgery but returned to baseline within 6 months³⁵. No differences in sexual function for women³¹ or urological function for men^{29,30,40} were described between the two approaches.

Discrepancies in results were found between studies that used the EORTC questionnaires to measure QoL. Emotional functioning scores favoured LapTME in the study by Bjoern and co-workers²⁹ but were reported to favour TaTME by Mora *et al.*³⁴. A difference in follow-up was suggested as an explanatory factor because median follow-up was 22.7 months for TaTME but 75.1 months for LapTME in the Bjoern study. The duration of follow-up was also suggested to explain the differences in individual domains described by Velcamp Helbach *et al.*³⁰ (role function, fatigue and faecal incontinence in favour of LapTME). Overall, QoL and global health status were comparable between the TaTME and LapTME groups. In terms of buttock pain²⁹ and faecal incontinence³⁰, QoL was worse after TaTME. It is remarkable that these QoL deteriorations were not detected by the functional assessment tools used in these studies.

Overall, reporting of the included studies was complete, except for the conference abstracts that were obviously restricted in reporting, and some did not report all QoL domains³⁴. A wide variety of adequate and valid questionnaires were used to assess QoL and functional outcomes^{52,53}. The overall quality of evidence was moderate, owing to considerable heterogeneity, lack of baseline measurements and relatively small sample sizes. The heterogeneity may have been the result of wide selection criteria, but these were specifically chosen to allow review of all available functional TaTME data. Additional treatment, preoperative function, height of the tumour and anastomosis, and differences in follow-up times were important factors contributing to heterogeneity and the interpretation of functional outcomes²⁰. Height of anastomosis was not reported systematically, but was significantly lower among patients who underwent TaTME in the study of Mosquera and colleagues⁴⁵. In other

comparative studies, no relevant differences in tumour height (in centimetres) and site (mid, low, high) were found. Six of eight studies properly described the rate of neoadjuvant therapy, and generally patients in the TaTME group underwent neoadjuvant therapy less frequently, yet this difference was not statistically significant.

The main limitation of this study is the lack of large RCTs. The majority of the studies were heterogeneous comparative studies and only seven of 20 reported preoperative baseline measurements. In addition, the surgeon's learning curve was reported poorly⁵⁴. These limitations make it difficult to reach firm conclusions. However, it is important to draw attention to the oncological concerns surrounding TaTME: an unexpected pattern of recurrences early after TaTME resulted in a moratorium in Norway¹⁰. Several studies^{55–65} are currently investigating different aspects of transanal methods of TME surgery. The COLOR III trial⁶⁶ is comparing TaTME with LapTME in a large cohort that should provide decisive data about the safety of TaTME.

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Supporting information

Additional supporting information can be found online in the Supporting Information section at the end of the article.