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REVIEW

Functional outcomes after transanal ileal pouch–anal anastomosis for ulcerative colitis: narrative review of the current literature

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Abstract

The transanal approach to ileal pouch–anal anastomosis (Ta-IPAA) for ulcerative colitis was introduced in 2015 and has since been shown to be a safe and feasible technique, although the impact of this approach on patient function remains unclear. A systematic literature review was performed to identify studies exploring functional outcomes and quality of life after Ta-IPAA. Seven papers were identified, which all demonstrated satisfactory functional outcomes after Ta-IPAA as measured by tools such as Cleveland Global Quality of Life (CGQOL), Oresland Score (OS), Pouch Functional Score (PFS), and Inflammatory Bowel Disease Questionnaire (IBDQ). Many gaps in the literature were identified including paucity of follow-up data beyond the 1-year mark, lack of fertility and fecundity assessment as functional outcomes, and limited evaluation of objective physiologic anal sphincter function. The Ta-IPAA therefore shows promise for good functional results in the short-term, although further research will be required to evaluate the stability of function over time as the technique becomes increasingly integrated into modern surgical practice.

Keywords Ulcerative colitis · Transanal ileal pouch–anal anastomosis · Function · Quality of life

Introduction

Multiple indications for total proctocolectomy with ileal pouch–anal anastomosis (IPAA) exist, but the most common is for the management of medically refractory ulcerative colitis (UC). IPAA, also referred to as restorative proctocolectomy (RPC), represents the gold standard surgical approach to medically refractory UC [1]. Advances in biologic therapy may contribute to decreased rates of surgery for patients with UC, but this trend has not been demonstrated across large-scale reviews, with approximately 15% of patients are still likely to require surgery at some point [2–6]. Patients with UC are often younger and expect to return to a normal quality of life (QoL) and high level of functioning once recovered from surgery. Many often have specific future goals relating to fertility and social participation. As a result, there is significant interest in the pursuit of minimally invasive surgery in this population, with a careful focus on long-term functional outcomes.

Function and QoL after IPAA have been extensively studied. A 2007 review by McGuire et al. incorporating 30 years of follow-up with IPAA demonstrated good outcomes for QoL, sexual function, fertility, and stool frequency [7]. The 2013 Danish population study was another large cross-sectional assessment of long-term functional outcomes after IPAA which found good function and high patient satisfaction after long-term follow-up [8]. Another large prospective database study by Hahnloser et al. demonstrated that although some aspects of bowel function worsened over the period of follow-up, overall QoL was unchanged and remained excellent [9]. Of their surveyed patients, 92% remained employed in the same occupation further illustrating the high level of function patients were able to maintain [9]. Function and QoL in IPAA patients have thus been shown to remain stable over time.

Transanal approaches to rectal surgery and pelvic dissection have been increasingly adopted over the last

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decade. Initially described for total mesorectal excision (TME) for rectal cancer, the transanal technique for ileal pouch–anal anastomosis (Ta-IPAA) was first reported in 2015 [10]. While the laparoscopic approach to pelvic surgery is the current gold standard minimally invasive approach, the transanal approach has been proposed as an alternative to overcome difficulties in posterior rectal dissection and distal rectal transection. Since its development, the safety and feasibility profile of Ta-IPAA is well established [11–15] and was well summarized in a 2019 review by de Lacy et al. [16]. While Ta-IPAA has been shown to be safe, with comparable rates of postsurgical complications to transabdominal IPAA, there has been hesitancy in adoption of the technique. One specific concern is the potential impact of transanal platforms with prolonged anal sphincter stretching on subsequent long-term pouch function [17]. With the recent movement towards Ta-IPAA in the UC population, there is interest in better understanding the functional consequences of transanal approaches on long-term pouch function. The aim of this review is to discuss the current state of the literature on functional outcomes after Ta-IPAA and to identify gaps within the current body of literature and areas for future research.

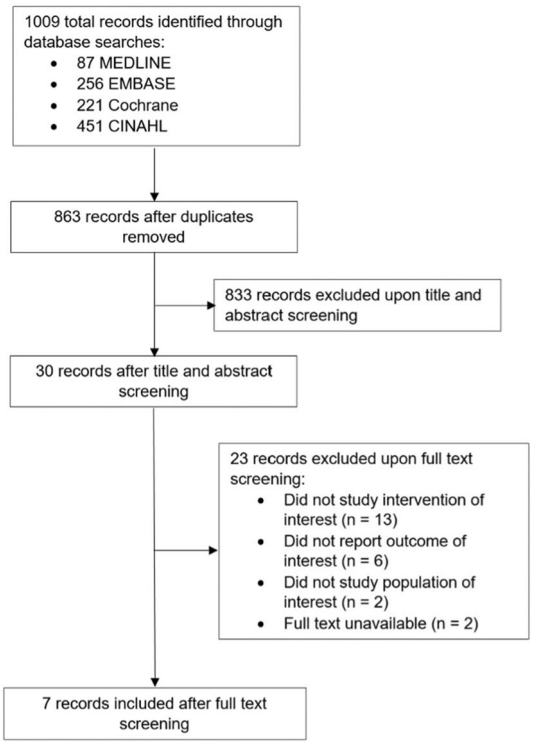

Fig. 1 PRISMA flow chart

Methods

A systematic review of the literature was performed in line with PRISMA guidelines. Broad search terms were used to identify a wide range of functional outcomes, surgical methods, and patient populations. Search terms included Inflammatory Bowel Disease, Ulcerative Colitis, Transanal, Total Mesorectal Excision, TaTME, Proctocolectomy, Proctectomy, Ileal Pouch, and Anal Anastomosis. The search was conducted in Medline, Embase, and Cochrane to include papers published in English. Date of publication was not restricted, and included papers were published up to and including October 2022. Titles and abstracts were subsequently reviewed for relevance between two independent screeners. The PRISMA flow chart is presented in Fig. 1. The target articles were reviewed in depth with thematic and narrative analysis and pertinent results were summarized with descriptive statistics when appropriate. Methodological analysis was limited given the heterogeneity of outcomes.

Results

We identified seven papers which addressed the topic of function after Ta-IPAA [18–24]. There were no randomized control trials (RCTs). A summary of the demographics of the identified trials is presented in Table 1. A summary of the functional results and scores is presented in Table 2. A variety of outcome measures were used across the studies to assess overall quality of life, measures of pouch function, sexual function, continence, bowel frequency, episodes of incontinence, and episodes of pouchitis.

QoL was evaluated in three of the seven papers using the Cleveland Global Quality of Life (CGQOL). Bislenghi et al. compared functional outcomes and long-term quality of life (QOL) in patients with UC undergoing transabdominal IPAA vs. Ta-IPAA [18]. Patients with cancer undergoing TaTME were excluded. A total of 108 patients were included with 38 having undergone Ta-IPAA. Patients were surveyed at 1, 3, 6, and 12 months postoperatively. CGQOL scores were noted to be higher in the Ta-IPAA group throughout the entire study period, with scores of 82.7 at 12 months vs. 75.5 in the transabdominal group [18]. Capolupo et al. reported a small ($n=8$) single-center retrospective study assessing Ta-IPAA [19]. Outcomes were assessed within 6 months of diverting stoma closure, or 12 months from initial pouch creation. CGQOL scores were considered high, with a mean final utility score of 0.65 [19]. Chandrasinghe et al. published a prospective, multicenter cohort study assessing function at 12 months postoperatively [20]. A total of 100 patients underwent Ta-IPAA, compared with 274 having undergone the transabdominal approach during the study period and the two groups demonstrated similar mean scores (75 vs. 71, $p=0.11$) [20]. The individual

Table 1 Key demographic information of the included studies

	Country	Design	Sample size (total)	Sample size (Ta-IPAA)	Male gender (%)	Mean age (years)	Anastomotic leak (%)
Bislenghi et al.	Belgium	RC	108	38	14 (36.8)	38	3 (7.9)
Capolupo et al.	Italy	PC	8	8	5 (62.5)	54 (median)	0 (0)
Chandrasinghe et al.	UK	PC	374	100	55 (55)	39	6 (6)
Hanke et al.	Germany	CR	1	1	0 (0)	47	0 (0)
Harslof et al.	Germany	PC	98	98	60 (61.2)	35 (median)	4 (4)
Lask et al.	Germany	RC	22	22	14 (63.6)	32 (median)	2 (9)
Tasende et al.	Spain	PC	18	18	13 (72)	40	0 (0)

RC retrospective cohort, *PC* prospective cohort, *CR* case report, *Ta-IPAA* transanal technique for ileal pouch–anal anastomosis

Table 2 Summary of scores of commonly used evaluation tools in the group of studies reviewed

	CGQOL	PFS	OS	IBDQ	SF-36	IIEF	IEFS-5	FSFI	WCGS
Bislenghi et al.	82.5	6.1	4.6	N/A	N/A	N/A	N/A	N/A	N/A
Capolupo et al.	64.6	N/A	N/A	N/A	N/A	23 (mean)	N/A	28 (mean)	1.6 (mean at 6 m)
Chandrasinghe et al.	75	N/A	N/A	N/A	N/A	N/A	19.69 (median)	18.86 (median)	N/A
Hanke et al.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	33	2
Harslof et al.	N/A	N/A	N/A	188	N/A	N/A	N/A	N/A	N/A
Lask et al.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tasende et al.	N/A	N/A	4.7	N/A	N/A	N/A	N/A	N/A	1.4

CGQOL Cleveland Global Quality of Life, *PFS* Pouch Functional Score, *OS* Oresland Score, *IBDQ* Inflammatory Bowel Disease Questionnaire, *SF-36* 36-Item Short Form Health Survey, *IIEF* International Index of Erectile Function, *IEFS-5* International Erectile Function Score, *FSFI* Female Sexual Function Index, *WCGS* Wexner Continence Grading Scale, *N/A* not applicable

components of the CGQOL were subsequently compared, and the Ta-IPAA group had significantly higher scores for energy level and quality of health domains. The analysis was then performed after exclusion of patients who suffered from an anastomotic leak postoperatively (6% in Ta-IPAA vs. 13% in transabdominal), and the CGQOL scores were still not found to be significantly different between groups. Subgroup analysis was performed comparing the technical approaches of TME with close rectal dissection (CRD), and there was no significant difference in CGQOL [20].

The Pouch Functional Score (PFS) and Oresland Score (OS) were two other tools used to evaluate overall function. Bislenghi et al. reported a gradual decrease in propensity matched PFS and OS scores over the study period, with no significant difference in evolution of pouch function or overall scores by the 12-month follow-up [18]. PFS was higher in the Ta-IPAA group at the 1-month mark (12.2 vs 10.8), representing worse function, though this was not statistically significant [18]. Tasende et al. reported functional outcomes which were initially assessed at 3 months after diverting ileostomy closure [24]. Mean OS was 4.7, with 0 representing perfect function [24].

The Inflammatory Bowel Disease Questionnaire (IBDQ) was used by Harslof et al. in their measurement of overall function [22]. Harslof et al. reported two sub-studies within their publication [22]. The first was a cohort study of 98 consecutive patients undergoing Ta-IPAA in a single institution. The second, a case–control, utilized data from the 2013 Danish pouch study and compared it to a newly collected data set from the cohort of patients undergoing Ta-IPAA since its introduction. Median length of follow-up was 44.5 months in the Ta-IPAA group, and 11 years in the historical cohort, though patients were then excluded if further than 10 years out from surgery. Male and female patients were evaluated separately in their responses to the IBDQ and showed similar scores for Ta-IPAA and transabdominal IPAA (IBDQ male patients 192 vs. 181, $p=0.08$; IBDQ female patients 177 vs. 161, $p=0.22$) [22].

Three of the seven studies assessed sexual function in their analysis of outcomes. Capolupo et al. used the International Index of Erectile Function (IIEF) and Female Sexual Function Index (FSFI) respectively and found rates of sexual dysfunction to be low among both genders, with mean reported scores of 24/30 in men (28/30 if excluding the one patient who suffered complete loss of sexual function) and 27/36 in women [19]. One male patient reported complete loss of sexual function, which was attributed to advanced age (71). Chandrasinghe et al. performed a

subgroup analysis evaluating sexual function which showed no significant differences in median scores between groups using the International Erectile Function Score (IEFS-5) and FSFI respectively (19.69 vs. 20.84; 18.86 vs. 17.12) [20]. Hanke et al. describe a case report of a high-risk patient who underwent combined laparoscopic and transanal total proctocolectomy for UC-associated colonic carcinoma [21]. In their patient, FSFI was reported to be 33 at the 3 months postoperatively [21]. Lask et al. conducted a retrospective analysis of prospectively collected data on a series of 22 patients undergoing Ta-IPAA for UC [23]. There were no reported incidences of sexual or bladder dysfunction [23].

Continence was assessed in three studies using the Wexner Continence Grading Scale (WCGS), with a score of 0 representing perfect continence and 20 representing complete incontinence. In Capolupo et al.'s study, WCGS scores ranged between 0 and 5 at 1 month from surgery and 0–4 at 6 months, indicating good overall continence [19]. In Hanke et al.'s study, WCGS was 2 at the time of 3 month follow-up [21]. Tasende et al. found a mean WCGS of 1.4 at 3 months after closure of diverting loop ileostomy [24].

Bowel function was reported using various additional quantitative measures. Chandrasinghe et al. investigated outcomes including stool frequency < 10/24 h, episodes of incontinence, and rates of pouch failure, which they found to be comparable between Ta-IPAA and transabdominal groups (78% vs. 79%, $p = 0.77$; 27% vs. 26%, $p = 0.8$; 1% vs. 3%; $p = 0.85$) [20]. Subgroup analysis comparing TME and CRD found no significant difference in episodes of major incontinence. Though not reaching statistical significance, rates of stool frequency > 10/24 h were found to be higher in the CRD group (27% vs. 15% in TME group, $p = 0.21$) [20]. Hanke et al. reported 24-h bowel frequency as 10 in the immediate postoperative period and 5 at 3-month follow-up [21]. Harslof et al. found no difference in bowel frequency between the open and Ta-IPAA patients (average 4–10/24 h) [22]. Other reported variables included stool consistency, urge to defecate, minor and major incontinence, use of pads and antidiarrheal medication, and incomplete evacuation. There was no significant difference between groups regarding any of the outcomes, with all $p > 0.05$ [22]. Lask et al. assessed short- and long-term functional outcomes within the first 3 months and 1–5 years respectively [23]. Stool frequency was reported for 11/22 patients in the short term, with median stool frequency of 9–10 bowel movements per 24-h period and intermittent incontinence reported in only four patients [23]. Long-term assessments of stool frequency and episodes of continence were not reported. Tasende et al. reported a mean 24-h stool frequency of 5.5 as measured at 3 months out from ileostomy closure [24].

Lask et al. were the only group to report on long-term pouch-related complications [23]. Nineteen patients were followed in the long term with 11/19 developing pouchitis during the follow-up period and 3/19 developing fistulae. Of the patients developing pouchitis, 8/11 were managed successfully with pharmacologic therapy and only 1 patient had persistent severe symptoms leading to recommendation for pouch excision, though this was not completed. One patient developed stenosis. Most patients (12/19) in the long-term follow-up group were assessed for 2–3 years following surgery.

All studies in this review included brief data on rates of postsurgical complications, specifically anastomotic leaks. There were no reported incidences of urethral injury or carbon dioxide embolism, both of which are described newer complications of TaTME. Bislenghi et al. report comparable leak rates between groups, with 7.9% incidence in the Ta-IPAA group vs. 5.6% in the transabdominal group ($p = 0.69$) [18]. Capolupo et al. did not experience any occurrences of anastomotic leak in their cohort of patients [19]. Chandrasinghe et al. report higher leak rates in the transabdominal group, though the finding did not reach statistical significance (13% vs. 6%, $p = 0.09$) [17]. The patient described in the case report by Hanke et al. did not experience any complications [21]. Harslof et al. had a 4% incidence of anastomotic leak in the Ta-IPAA group, with all patients requiring antibiotics and drainage [22]. Lask et al. reported a 9% (2/22 patients) incidence of anastomotic leak, with both patients being managed with endosponge therapy [23]. In the series reported by Tasende et al., there was no incidence of major complications [24]. These results add to the growing body of literature describing the safety of Ta-IPAA, and thus will contribute to its ongoing implementation into routine practice.

Discussion

Despite the small size of the current body of literature, the results suggest comparable if not improved functional outcomes of Ta-IPAA in comparison to traditional transabdominal IPAA. QoL was rated highly overall throughout the first postoperative year as demonstrated by high scores on the CGQOL, PFS, and OS. Sexual function and continence were also preserved as measured by IEFS-5, IIEF, FSFI, and WCGS. The 24-h bowel frequency was reported as less than 10 in all the studies reporting qualitative outcomes, and episodes of incontinence were infrequent [20, 21]. The results of this review are in line with prior research on functional outcomes and QoL after transabdominal IPAA. Given that short- and medium-term outcomes have been positively predictive of good long-term function in the transabdominal IPAA population, we anticipate the same to be true of long-term function in the Ta-IPAA cohorts in light of the high QoL and functional scores as assessed in the short term.

The results of this review are also in line with the consensus in the literature regarding functional outcomes after transanal endoscopic microsurgery (TEM) and TaTME after rectal cancer. Allaix et al. presented long-term outcomes after TEM, following patients for up to 60 months utilizing WCGS and anorectal manometry as markers of function [17]. Although both measures showed some abnormality at early assessment, both had returned to baseline presurgery values by 12 months. Functional outcomes after TaTME for rectal cancer have also been in favor of good results from the transanal approach. A recent systematic review and meta-analysis by Choy et al. demonstrated similar anorectal functional outcomes and low anterior resection syndrome (LARS) scores between transanal and laparoscopic surgical approaches [25]. Genitourinary functional scores were also similar. Results such as these have helped to set the stage for the implementation of transanal surgery in the realm of IPAA.

One notably absent outcome in the literature is the assessment of postoperative fertility and fecundity. It has been previously well investigated that IPAA can have significant impacts on the future fertility of patients with UC [26]. Previous meta-analyses have shown as high as a threefold increased risk of infertility after undergoing IPAA [27]. Specific procedural factors contributing to this finding have not been identified, though postulated theories include pelvic postsurgical adhesions and obstruction of the fallopian tubes [26]. It is thought that minimally invasive surgical approaches may help to mitigate the risks of infertility, but this has not been conclusively proven. The ultra-minimally invasive Ta-IPAA may therefore have a beneficial effect on this critical outcome. The absence of study in the Ta-IPAA population may reflect the novelty of this approach and lack of long-term follow-up data. The importance of this functional outcome cannot be understated and should certainly be prioritized as an area of study. Furthermore, another significant limitation of this study is the lack of follow-up data beyond the 1-year mark postoperatively in the currently available literature, with only a single study following patients beyond the first year. Longer-term data will be important in educating this young population on expectations for function over decades in the future.

An additional area of important future study will be the investigation of objective measurements of pouch function. Previous attempts to determine correlation between physiologic, biochemical, and endoscopic testing and pouch function have been somewhat inconclusive. A 2017 study by Sunde et al. compared PFS scores with fecal calprotectin, findings of pouch endoscopy, and results of manovolumetric testing in an attempt to correlate these objective measures with subjectively scored function [28]. Although some differences in function were detected, such as larger pouch volumes correlating with better PFS scores, the results of the study did not shed further light on the wide variation of function experienced by pouch patients. Interestingly, there was no significant correlation between resting anal pressure or maximum anal squeeze pressure and PFS scores. This would call into question the anecdotal and logistical concern of Ta-IPAA leading to worse function based on prolonged anal stretch from the surgical platforms. The Sunde group also subsequently endeavored to determine whether structural and functional findings on MRI defecogram could predict pouch function and did not identify any such relationships [29]. Given the specific concerns regarding the impact of transanal platforms on subsequent anal and IPAA functions, further research into structural and physiological testing for function will be essential.

The authors recognize some limitations to this study. Specifically, the quality of this study synthesis is limited by the preliminary evidence base. There were no RCTs in the current body of literature, although the authors are aware of a currently recruiting trial comparing functional outcomes after transanal and laparoscopic vs. open IPAA which will greatly enhance the current state of knowledge on this critical topic (ClinicalTrials.gov Identifier NCT04722757). Many of the included studies used heterogeneous patient functional scoring systems, which limited the capacity to conduct quantitative analyses. The most frequently used tool to evaluate postoperative function was the CGQOL questionnaire, a tool which has been specifically validated in RPC for UC [30]. It covers three domains—current quality of life, current quality of health, and energy levels. The CGQOL has gained popularity as it is easy to use and interpret and provides a good overall picture of patient satisfaction with daily life and function. The PFS is another measurement specifically validated in the RPC population [31]. The PFS incorporates domains including stool frequency, urgency, incontinence, and use of medications (antidiarrheals, antibiotics). It has shown good correlation with CGQOL in multivariable analysis [31]. The OS similarly assesses parameters relating to bowel function including 24-h stool frequency, nighttime defecation frequency, urgency, pad use, soiling, perianal pain, dietary restriction, use of medication for stool frequency management, and social handicap [32]. OS has been previously shown to have good correlation with PFS [32]. The scoring tools used for assessment of sexual function and continence are not specifically validated in the population of interest.

Conclusion

Despite a paucity of literature, the preliminary assessments of function after Ta-IPAA show promise for good short-term function. Acceptable outcomes were demonstrated across

assessment tools looking at both global QoL and specific functional parameters. Other areas important for future study have been identified including impact of Ta-IPAA on subsequent fertility and fecundity, and the objective assessment of sphincter function. As the transanal technique becomes increasingly implemented over time, further studies can comment on whether adequate function remains stable over the longer term. To the authors' knowledge, this is the first systematic review seeking to characterize the functional outcomes after Ta-IPAA. In doing so, we hope to better support preoperative decision-making for patients with inflammatory bowel disease and support the ongoing widespread implementation of this technique which represents an exciting advance in the field of coloproctology.

Author Contribution All authors contributed to the study design and execution. Design of the study question and systematic review were performed by DN, SK, and JV. The first draft of the manuscript was written by JV and all authors commented on prior versions. All authors read and approved of the final manuscript.

Data availability Data sharing not applicable to this article as no datasets were generated or analysed during the current study.

Declarations

Conflict of interest The authors declare that they have no conflict of interest. The authors have no financial disclosures.

References

1. Sofo L, Caprino P, Sacchetti F, Bossola M (2016) Restorative proctocolectomy with ileal pouch-anal anastomosis for ulcerative colitis: a narrative review. World J Gastrointest Surg 8(8):556–563. https://doi.org/10.4240/wjgs.v8.i8.556
2. Olivera P, Spinelli A, Gower-Rousseau C, Danese S, Peyrin-Biroulet L (2017) Surgical rates in the era of biologic therapy: up, down or unchanged? Curr Opin Gastroenterol 33(4):246–253. https://doi.org/10.1097/MOG.0000000000000361
3. Kuehn F, Hodin RA (2018) Impact of modern drug therapy on surgery: ulcerative colitis. Visc Med 34(6):426–431. https://doi.org/10.1159/000493492
4. Yamamoto T, Carvello M, Lightner AL, Spinelli A, Kotze PG (2020) Up-to-date surgery for ulcerative colitis in the era of biologics. Expert Opin Biol Ther 20(4):391–398. https://doi.org/10.1080/14712598.2020.1718098
5. Atia O, Orlanski-Meyer E, Lujan R et al (2022) Colectomy rates did not decrease in paediatric- and adult-onset ulcerative colitis during the biologics era: a nationwide study from the epi-IIRN. J Crohns Colitis 16(5):796–803. https://doi.org/10.1093/ecco-jcc/jjab210
6. Di Candido F, Fiorino G, Spadaccini M, Danese S, Spinelli A (2019) Are surgical rates decreasing in the biologic era in IBD? Curr Drug Targets 20(13):1356–1362. https://doi.org/10.2174/1389450120666190426165325
7. McGuire BB, Brannigan AE, O'Connell PR (2007) Ileal-pouch anal anastomosis. Br J Surg 94(7):812–823. https://doi.org/10.1002/bjs.5866
8. Brandsborg S, Tottrup A, Nicholls J, Laurberg S (2013) Restorative proctocolectomy in patients with ulcerative colitis: a cross sectional Danish population study on function and quality of life. Colorectal Dis 15(8):e453–e461. https://doi.org/10.1111/codi.12270
9. Hahnloser D, Pemberton JH, Wolff BG, Larson DR, Crownhart BS, Dozois RR (2007) Results at up to 20 years after ileal pouch-anal anastomosis for chronic ulcerative colitis. Br J Surg 94:333–340. https://doi.org/10.1002/bjs.5464
10. Coffey JC, Dillon MF, O'Driscoll JS, Faul E (2016) Transanal total mesocolic excision (taTME) as part of ileoanal pouch formation in ulcerative colitis—first report of a case. Int J Colorectal Dis 31:735–736. https://doi.org/10.1007/s00384-015-2236-4
11. Leo CA, Samaranayake S, Perry-Woodford ZL et al (2016) Initial experience of restorative proctocolectomy for ulcerative colitis by transanal total mesorectal excision and single-incision abdominal laparoscopic surgery. Colorectal Dis 18(12):1162–1166. https://doi.org/10.1111/codi.13359
12. Buck Overstraeten A, Mark-Christensen A, Wasmann KA et al (2017) Transanal versus transabdominal minimally invasive (completion) proctectomy with ileal pouch anal anastomosis in ulcerative colitis—a comparative study. Ann Surg 266(5):878–883. https://doi.org/10.1097/SLA.0000000000002395
13. Zaghiyan K, Warusavitarne J, Spinelli A, Chandrasinghe P, Di Candido F, Flesher P (2018) Technical variations and feasibility of transanal ileal pouch-anal anastomosis for ulcerative colitis and inflammatory bowel disease unclassified across continents. Tech Coloproctol 22:867–873. https://doi.org/10.1007/s10151-018-1889-8
14. Park L, Truong A, Zaghiyan K, Fleshner P (2022) A single-centre comparative study of open transabdominal and laparoscopic transanal ileal pouch-anal anastomosis with total mesorectal excision: has the bar been raised? J Gastrointest Surg 26:1070–1076. https://doi.org/10.1007/s11605-021-05236-2
15. Ashitomi Y, Oshio H, Yano M, Okazaki S, Motoi F (2021) Laparoscopic proctocolectomy with transanal total mesorectal excision for ulcerative colitis. Cureus 13(11):e19720. https://doi.org/10.7759/cureus.19720
16. de Lacy FB, Keller DS, Martin-Perez B, Emile SH, Chand M, Spinelli A, de Lacy A (2019) The current state of the transanal approach to the ileal pouch-anal anastomosis. Surg Endosc 33(5):1368–1375. https://doi.org/10.1007/s00464-019-06674-5
17. Allaix ME, Rebecchi F, Giaccone C, Mistrangelo M, Morino M (2011) Long-term functional results and quality of life after transanal endoscopic microsurgery. Br J Surg 98:1635–1643. https://doi.org/10.1002/bjs.7584
18. Bislenghi G, Denolf M, Fieuws S, Wolthius A, D'Hoore A (2022) Functional outcomes of transanal versus transabdominal restorative proctectomy with ileal pouch-anal anastomosis in ulcerative colitis—a monocentric retrospective comparative study. Langenbecks Arch Surg 407(8):3607–3614. https://doi.org/10.1007/s00423-022-02640-3
19. Capolupo GT, Carannante F, Masciana G, Lauricella S, Mazzotta E, Caricato M (2021) Transanal proctocolectomy and ileal pouch-anal anastomosis (TaIPAA) for ulcerative colitis: medium term functional outcomes in a single centre. BMC Surg 21(17):1–7. https://doi.org/10.1186/s12893-020-01007-z
20. Chandrasinghe P, Carvello M, Wasmann K et al (2020) Transanal ileal pouch-anal anastomosis for ulcerative colitis has comparable long-term functional outcomes to transabdominal approach: a multicentre comparative study. J Crohns Colitis 14(6):726–733. https://doi.org/10.1093/ecco-jcc/jjz174
21. Hanke LI, Bartsch F, Forsch S, Heid F, Lang H, Kneist W (2016) Transanal total mesorectal excision or restorative coloproctectomy in an obese high-risk patient with colitis-associated carcinoma.

Minim Invas Ther Allied Technol 26(3):188–191. https://doi.org/10.1080/13645706.2016.1264426
22. Harslof S, Pachler FR, Thaysen HV, Drejer M, Brandsborg S, Norager CB, Tottrup A (2022) Functional outcome and quality of life after transanal minimal invasive pouch surgery. Int J Colorectal Dis 37:1141–1150. https://doi.org/10.1007/s00384-022-04158-y
23. Lask A, Biebl M, Dittrich L et al (2021) Safety of transanal ileal pouch-anal anastomosis for ulcerative colitis: a retrospective observational cohort study. Patient Saf Surg 15(31):1–9. https://doi.org/10.1186/s13037-021-00306-5
24. Tasende MM, Delgado S, Jiminez M et al (2015) Minimally invasive surgery: NOSE and NOTES in ulcerative colitis. Surg Endosc 29:3313–3318. https://doi.org/10.1007/s00464-015-4087-z
25. Choy KT, Yang TWW, Prabhakaran S, Heriot A, Kong JC, Warrier SK (2021) Comparing functional outcomes between transanal total mesorectal excision (TaTME) and laparoscopic total mesorectal excision (LaTME) for rectal cancer: a systematic review and meta-analysis. Int J Colorectal Dis 36(6):1163–1174. https://doi.org/10.1007/s00384-021-03849-2
26. Bharadwaj S, Philpott JR, Barber MD, Graff LA, Shen B (2014) Women's health issues after ileal pouch surgery. Inflamm Bowel Dis 20(12):2470–2482. https://doi.org/10.1097/MIB.0000000000000171
27. Waljee A, Waljee J, Morris AM, Higgins PDR (2006) Threefold increased risk of infertility: a meta-analysis of infertility after ileal pouch anal anastomosis in ulcerative colitis. Gut 55:1575–1580. https://doi.org/10.1136/gut.2005.090316
28. Sunde ML, Negard A, Oresland T, Bakka N, Geitung JT, Faerden AE (2018) MRI defecography of the ileal pouch-anal anastomosis—contributes little to the understanding of functional outcome. Int J Colorectal Dis 33(5):609–617. https://doi.org/10.1007/s00384-018-3011-0
29. Sunde ML, Ricanek P, Oresland T, Jahnsen J, Naimy N, Faerden AE (2018) Determinants of optimal bowel function in ileal pouch-anal anastomosis—physiological differences contributing to pouch function. Scand J Gastroenterol 53(1):8–14. https://doi.org/10.1080/00365521.2017.1390601
30. Fazio VW, O'Riordain MG, Lavery IC, Church JM, Lau P, Strong SA, Jull T (1999) Long-term functional outcome and quality of life after stapled restorative proctocolectomy. Ann Surg 230(4):575–584. https://doi.org/10.1097/00000658-199910000-00013
31. Lovegrove RE, Fazio VW, Remzi FH, Tilney HS, Nicholls RJ, Tekkis PP (2010) Development of a pouch functional score following restorative proctocolectomy. Br J Surg 97(6):945–951. https://doi.org/10.1002/bjs.7021
32. Oresland T, Fasth S, Nordgren S, Hulten L (1989) The clinical and functional outcome after restorative proctocolectomy. A prospective study in 100 patients. Int J Colorectal Dis 4(1):50–56