Systematic Review and Meta-Analysis

Medicine

OPEN

# Laparoscopic total mesorectal excision versus transanal total mesorectal excision for mid and low rectal cancer

## A systematic review and meta-analysis

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**Abstract**

**Background:** Laparoscopic total mesorectal excision (LaTME) and transanal total mesorectal excision (TaTME) are popular mid and low rectal cancer trends. However, there is currently no systematic comparison between LaTME and TaTME of mid and low rectal cancer. Therefore, we systematically study the perioperative and pathological outcomes of LaTME and TaTME in mid and low rectal cancer.

**Methods:** Articles included searching through the Embase, Cochrane Library, PubMed, Medline, and Web of science for articles on LaTME and TaTME. We calculated pooled standard mean difference (SMD), relative risk (RR), and 95% confidence intervals (CIs). The protocol for this review has been registered on PROSPERO (CRD42022380067).

**Results:** There are 8761 participants included in 33 articles. Compared with TaTME, patients who underwent LaTME had no statistical difference in operation time (OP), estimated blood loss (EBL), postoperative hospital stay, over complications, intraoperative complications, postoperative complications, anastomotic stenosis, wound infection, circumferential resection margin, distal resection margin, major low anterior resection syndrom, lymph node yield, loop ileostomy, and diverting ileostomy. There are similarities between LaTME and TaTME for 2-year DFS rate, 2-year OS rate, distant metastasis rat, and local recurrence rate. However, patients who underwent LaTME had less anastomotic leak rates (RR 0.82; 95% CI: 0.70–0.97; $I^2 = 10.6\%$, $P = .019$) but TaTME had less end colostomy (RR 1.96; 95% CI: 1.19–3.23; $I^2 = 0\%$, $P = .008$).

**Conclusion:** This study comprehensively and systematically evaluated the differences in safety and effectiveness between LaTME and TaTME in the treatment of mid and low rectal cancer through meta-analysis. Patients who underwent LaTME had less anastomotic leak rate but TaTME had less end colostomy. There is no difference in other aspects. Of course, in the future, more scientific and rigorous conclusions need to be drawn from multi-center RCT research.

**Abbreviations:** CIs = confidence intervals, EBL = estimated blood loss, LaTME = laparoscopic total mesorectal excision, MiTME = minimally invasive total mesorectal excision, RR = relative risk, SMD = standard mean difference, TaTME = transanal total mesorectal excision, TME = total mesorectal excision.

**Keywords:** laparoscopic total mesorectal excision, meta-analysis, mid and low rectal cancer, systematic review, transanal total mesorectal excision

## 1. Introduction

Total mesorectal excision (TME) is one of the gold standard for surgical treatment of middle and low rectal cancer, meanwhile an important protective factor for local recurrence of tumors and long-term survival of patients after surgery.[1] In recent years, laparoscopic total mesorectal excision has become the main means of clinical treatment for rectal cancer with its advantages of less trauma and quick recovery.[2,3] However, it is very difficult for male, obese, middle and low rectal cancer patients with large tumors after

*The authors declare that there is no involving Informed consent.*

*The authors have no conflicts of interest to disclose.*

*All data generated or analyzed during this study are included in this published article [and its supplementary information files].*

*There is not involve ethics because it is the system review and meta-analysis.*

*Not commissioned, externally peer-reviewed.*

*Supplemental Digital Content is available for this article.*

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*How to cite this article: Yi Chi Z, Gang O, Xiao Li F, Ya L, Zhijun Z, Yong Gang D, Dan R, Xin L, Yang L, Peng Z, Yi L, Dong L, De Chun Z. Laparoscopic total mesorectal excision versus transanal total mesorectal excision for mid and low rectal cancer: A systematic review and meta-analysis. Medicine 2024;103:4(e36859).*

*Received: 12 March 2023 / Received in final form: 5 December 2023 / Accepted: 14 December 2023*

*http://dx.doi.org/10.1097/MD.0000000000036859*

**Table 1**

**The main characteristics of included studies.**

| Author | Publication | Country | Study period | Study design | Group | Cases | Age | BMI (body mass index) (kg/m²) | Tumor size | Tumor height | Follow-up (mo) | Confounders adjustment | NOS score (max: 9) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alhanafy et al, 2020 | Diseases of the colon and rectum | South Korea | 2014–2017 | Retrospective | LaTME | 202 | 61.50 ± 11.20 | 24.10 ± 3.40 | | | 34.0 (0.7–63.3) | Yes (propensity score matching) | 8 |
| | | | | | TaTME | 202 | 62.40 ± 9.98 | 24.02 ± 3.10 | | | 34.0 (0.7–63.3) | | |
| Bedrikovetski et al, 2020 | Dis Colon Rectum | Australia | 2007–2018 | Retrospective | LaTME | 1269 | 66 (18–97) | | | 8 (0–18) | | No | 8 |
| | | | | | TaTME | 85 | 64 (32–86) | | | 7 (1–15) | | | |
| Bjoern et al, 2019 | J Gastrointest Surg | Denmark | 2010–2017 | Prospective | LaTME | 36 | 62.42 ± 10.146 | 25.45 ± 4.811 | | 8.14 ± 1.885 | 75.08 | No | 7 |
| | | | | | TaTME | 49 | 64.88 ± 9.645 | 26.57 ± 3.476 | | 8.35 ± 1.727 | 22.69 | | |
| Chang et al, 2018 | Journal of laparoendoscopic & advanced surgical techniques | China | 2014–2017 | Prospective | LaTME | 23 | 62.9–12.6 | 25.0–3.9 | 3.3–1.6 | 5.9–1.1 | | Yes (propensity score matching) | 8 |
| | | | | | TaTME | 23 | 62.4–12.9 | 25.8–4.3 | 3.2–2.1 | 4.3–1.4 | | | |
| Chen et al, 2019 | Asian journal of surgery | China | 2008–2018 | Retrospective | LaTME | 64 | 64.0 12.2 | 24.6 3.3 | 3.2 1.5 | | 37.5 23.7 | No | 8 |
| | | | | | TaTME | 39 | 62.0 14.9 | 25.4 4.0 | 3.6 2.2 | | 17.5 8.8 | | |
| Detering et al, 2019 | Journal of the American College of Surgeons | Netherlands | 2015–2017 | Prospective | LaTME | 396 | >75y, 23.2 | | | | | Yes (propensity score matching) | 9 |
| | | | | | TaTME | 396 | >75 y, 18.2 | | | | | | |
| Dou et al, 2019 | Zhonghua Wei Chang Wai Ke Za Zhi | China | 2016–2017 | Retrospective | LaTME | 53 | 62.0 (33.0–73.0) | 22.2(16.7–27.7) | | | 16.2(12.1–30.4) | No | 6 |
| | | | | | TaTME | 54 | 57.5 (26.0–77.0) | 21.5(17.8–33.2) | | | 17.9(12.1–30.4) | | |
| Fernandez-Hevia et al, 2015 | Annals of Surgery | Spain | 2011–2013 | Retrospective | LaTME | 37 | 69.5 ± 10.5 | | 2.7 ± 1.5 | | | Yes (propensity score matching) | 9 |
| | | | | | TaTME | 37 | 64.5 ± 11.8 | | 2.6 ± 1.4 | | | | |
| Hol et al, 2021 | The British journal of surgery | The Netherlands | 2015–2017 | Retrospective | LaTME | 490 | 68 (9.8) | 26 (4.4) | | | | No | 7 |
| | | | | | TaTME | 244 | 66 (11.0) | 26 (4.2) | | | | | |
| Jang et al, 2021 | Asian journal of surgery | Korea | 2009–2019 | Retrospective | LaTME | 182 | 66.68 (11.266) | 23.12 (3.894) | 5.0 (2.095) | | | No | 8 |
| | | | | | TaTME | 38 | 68.87 (12.034) | 22.82 (3.149) | 3.73 (2.974) | | | | |
| Li et al, 2022 | Surg Endosc | China | 2014–2019 | Retrospective | LaTME | 106 | 56 ± 12 (26–79) | 22:9 ± 3:2 (16.9–34.3) | 2:8 ± 2:0 (0–8.0) | | 30:29 ± 13:439 (1–73) | Yes (propensity score matching) | 7 |
| | | | | | TaTME | 106 | 55 ± 12 (23–78) | 23:0 ± 2:9 (17.2–32.3) | 3:0 ± 1:3 (0.3–6.6) | | 21:80 ± 18:153 (1–121) | | |
| Li et al, 2021 | Tech Coloproctol | China | 2014–2018 | Prospective | LaTME | 30 | *P* = .732 | 22.6 (19.3–27.6) | | | 22.2 | Yes (propensity score matching) | 8 |
| | | | | | TaTME | 30 | | 27.3 (24.4–32.5) | | | 13.8 | | |
| Liu et al, 2022 | Annals of Surgery | China | 2016–2021 | Prospective | LaTME | 545 | 60 (52–67) | 22.8 (20.9–24.8) | | | | No | 9 |
| | | | | | TaTME | 544 | 58 (50–67) | 22.9 (20.7–24.9) | | | | | |
| Mora et al, 2018 | Cir Cir | Spain | 2011–2014 | Prospective | LaTME | 15 | 64 | | | | | No | 7 |
| | | | | | TaTME | 16 | 59.95 | | | | | | |
| Munini et al, 2021 | Int J Colorectal Dis | Switzerland | 2012–2019 | Prospective | LaTME | 35 | 69.0 (59.0–74.0) | 25.1 (24.0–30.8) | 2.5 (2.0–3.9) | | 49.5 (22.6–68.5) | Yes (propensity score matching) | 7 |
| | | | | | TaTME | 35 | 67.0 (60.1–73.6) | 27.2 (23.8–28.9) | 2.5 (1.5–3.5) | | 30.6 (20.2–39.8) | | |
| Ong et al, 2021 | Am J Surg | USA | 2014–2019 | Retrospective | LaTME | 30 | 57.9 ± 10.9 | 28.7 ± 5.5 | | | 20.4 ± 15.9 | No | 8 |
| | | | | | TaTME | 20 | 61.4 ± 11.3 | 28.3 ± 5.2 | | | 24.9 ± 12.7 | | |
| Ose et al, 2021 | Colorectal Disease | Denmark | 2014–2018 | Prospective | LaTME | 1163 | 67.61 ± 10.254 | 26.52 ± 7.199 | | | | No | 8 |
| | | | | | TaTME | 312 | 65.65 ± 10.038 | 26.08 ± 4.419 | | | | | |
| Ourô et al, 2022 | Tech Coloproctol | Portugal | 2016–2018 | Retrospective | LaTME | 39 | 69 (61–76) | 27 (24–29) | | | 38 (24–63) | No | 8 |
| | | | | | TaTME | 44 | 66 (59–74) | 26 (23– 28) | | | 40 (31–48) | | |
| Perdawood et al, 2016 | Colorectal Disease | Denmark | 2013–2015 | Prospective | LaTME | 25 | 70 (4984) | 26 (1938) | 50 (2080) | 8 (510) | | Yes (propensity score matching) | 8 |
| | | | | | TaTME | 25 | 70 (5476) | 28 (1846) | 50 (2070) | 8 (410) | | | |

(*Continued*)

**Table 1**
**(Continued)**

| Author | Publication | Country | Study period | Study design | Group | Cases | Age | BMI (body mass index) (kg/m²) | Tumor size | Tumor height | Follow-up (mo) | Confounders adjustment | NOS score (max: 9) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Persiani et al, 2018 | Dis Colon Rectum | Italy | 2007–2017 | Prospective | LaTME<br>TaTME | 46<br>46 | 66.5 (28–86)<br>69 (36–94) | 25.6 (18.8–33.4)<br>25 (19.1–32.8) | 27 (3–80)<br>25 (8–75) | | | Yes (propensity score matching) | 8 |
| Pontallier et al, 2016 | Surg Endosc | France | 2008–2012 | Prospective | LaTME<br>TaTME | 34<br>38 | 62 (35–82)<br>62 (39–81) | 24.8 (18.3–38.3)<br>25.5 (17.3–33.2) | 4 (1–8)<br>4 (1.5–8) | | 78<br>73 | No | 7 |
| Rasulov et al, 2016 | Tech Coloproctol | Russia | 2013–2015 | Prospective | LaTME<br>TaTME | 23<br>22 | 26.0 (18.3–37.2)<br>26.0 (19.7–32.3) | 60 (15–78)<br>56 (30–69) | | 7 Median (cm)<br>6.5 Median (cm) | 11.4<br>11.4 | Yes (propensity score matching) | 8 |
| Ren et al, 2021 | Asian J Surg | China | 2017–2019 | Retrospective | LaTME<br>TaTME | 32<br>32 | 67.16 ± 10.03<br>65.78 ± 12.37 | 23.05 ± 2.70<br>22.87 ± 2.66 | 4.14 ± 1.89<br>4.20 ± 1.20 | | | Yes (propensity score matching) | 8 |
| Roodbeen et al, 2019 | Surg Endosc | Netherlands | 2013–2017 | Prospective | LaTME<br>TaTME | 41<br>41 | 66.0 ± 9.2<br>62.5 ± 10.7 | 26.1 ± 4.0<br>26.7 ± 1.9 | 43.0 (37.0–55.0)<br>46.5 (34.5–53.8) | | | Yes (propensity score matching) | 7 |
| Rubinkiewicz et al, 2018 | Cancer Manag Res | Poland | 2012–2014<br>2015–2018 | Prospective | LaTME<br>TaTME | 35<br>35 | 60.3 ± 10.2<br>64.3 ± 10.1 | 27.1 ± 4.71<br>26.1 ± 4.09 | | | | Yes (propensity score matching) | 8 |
| Rubinkiewicz et al, 2019 | BMC Surg | Poland | 2013–2017 | Prospective | LaTME<br>TaTME | 23<br>23 | 64 [58–67]<br>60 [51–67] | 26.5 [23.8–30.6]<br>26 [22.8–29.7] | | | | Yes (propensity score matching) | 6 |
| Sun et al, 2022 | Zhonghua Wei Chang Wai Ke Za Zhi | China | 2014–2020 | Retrospective | LaTME<br>TaTME | 52<br>52 | 59 ± 9<br>59 ± 10 | 24.3 ± 2.9<br>24.3 ± 3.2 | | | 72<br>72 | Yes (propensity score matching) | 6 |
| Veltcamp Helbach et al, 2018 | Surg Endosc | Netherlands | 2010–2012 | Retrospective | LaTME<br>TaTME | 27<br>27 | 62.7 (59.6–65.7)<br>68.0 (64.4–71.6) | 26.1 (25.1–27.3)<br>27.6 (25.7–29.5) | | | 59.5 (39.7–82.0)<br>20.0 (6.6–44.4) | Yes (propensity score matching) | 7 |
| Ye et al, 2021 | Eur J Surg Oncol | China | 2014–2019 | Retrospective | LaTME<br>TaTME | 70<br>70 | | 22.7 (±3.0)<br>23.5 (±3.5) | | | 20 (4–59)<br>18 (3–63) | Yes (propensity score matching) | 8 |
| Zeng et al, 2020 | Surgical Endoscopy and Other Interventional Techniques | China | 2016–2018 | Retrospective | LaTME<br>TaTME | 133<br>128 | 56.1 ± 10.9<br>56.1 ± 11.2 | 22.2 ± 2.9<br>22.5 ± 3.1 | 3.0 ± 1.3<br>3.2 ± 1.3 | | | No | 8 |
| Zeng et al, 2021 | Dis Colon Rectum | China | 2014–2018 | Retrospective | LaTME<br>TaTME | 171<br>171 | 59.1 ± 11.5<br>55.6 ± 12.6 | 22.6 ± 3.4<br>22.9 ± 3.1 | 3.0 ± 1.2<br>2.9 ± 1.2 | | 26 (15–36)<br>26 (15–36) | Yes (propensity score matching) | 8 |
| Zeng et al, 2022 | Surg Endosc | China | 2014–2017 | Retrospective | LaTME<br>TaTME | 208<br>104 | 58.3 ± 12.1<br>57.2 ± 11.9 | 22.5 ± 3.2<br>22.6 ± 3.0 | 3.3 ± 1.2<br>3.1 ± 1.2 | | 15 (1–32)<br>17 (6–35) | No | 7 |
| Zuhdy2020 | J Laparoendosc Adv Surg Tech A | Egypt | 2017–2019 | Prospective | LaTME<br>TaTME | 20<br>18 | 53.40–11.38<br>53.89–13.99 | 25.99–4.68<br>30.74–7.79 | | | | No | 7 |

Matching: 1 – Age; 2 – BMI; 3 – Tumor size; 4 – Tumor height; 5 – Follow-up.
LaTME = laparoscopic total mesorectal excision, NA = data not available, NOS score = Newcastle–Ottawa Scale score, TaTME = transanal total mesorectal excision.

neoadjuvant treatment or pelvic stenosis, whether through minimally invasive or laparotomy TME, which tends to lead to insufficient distal margin and increased positive rate of circumferential margin.[4] In this context, some scholars believe that transanal total mesorectal excision (taTME) can overcome the technical difficulties of minimally invasive total mesorectal excision (MiTME) in some cases and improve the quality of surgical specimens due to its good "bottom-up" anatomical vision.[5,6] Therefore, this study aims to provide more basis for clinical treatment decisions by comparing the impact of laparoscopic total mesorectal excision (LaTME) surgery and TaTME surgery on perioperative, intestinal function, and oncology results of rectal cancer patients.

## 2. Methods

### 2.1. Protocol and guidance

This study has been reported in line with PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses)[7] and AMSTAR (Assessing the methodological quality of systematic reviews) Guidelines. The protocol for this review has been registered on PROSPERO (CRD42022380067).

### 2.2. Search strategy

The study involved literature published in the Embase, PubMed, Cochrane Library, Medline, and Web of Science up to 30/11/2022. We defined the eligibility criteria according to the population (P), intervention (I), comparator (C), outcome, and study design approach (O).

P: The patients with mid and low rectal cancer.

I: undergoing laparoscopic total mesorectal excision.

C: transanal total mesorectal excision was performed as a comparator.

O: one or more of the following outcomes: perioperative period, postoperative, and oncologic outcomes.

The search terms included (laparotomy OR laparoscopy OR laparoscopic OR minimally invasive) AND (transanal OR perineal OR natural orifice) AND (colorectal cancer OR rectal cancer OR mesorectal excision OR TME OR proctectomy OR anterior resection OR abdominoperineal excision). The search strategy was not limited by language or year. It was not requested by the ethics or institutional review committee due to the study being designed as a systematic review and meta-analysis.

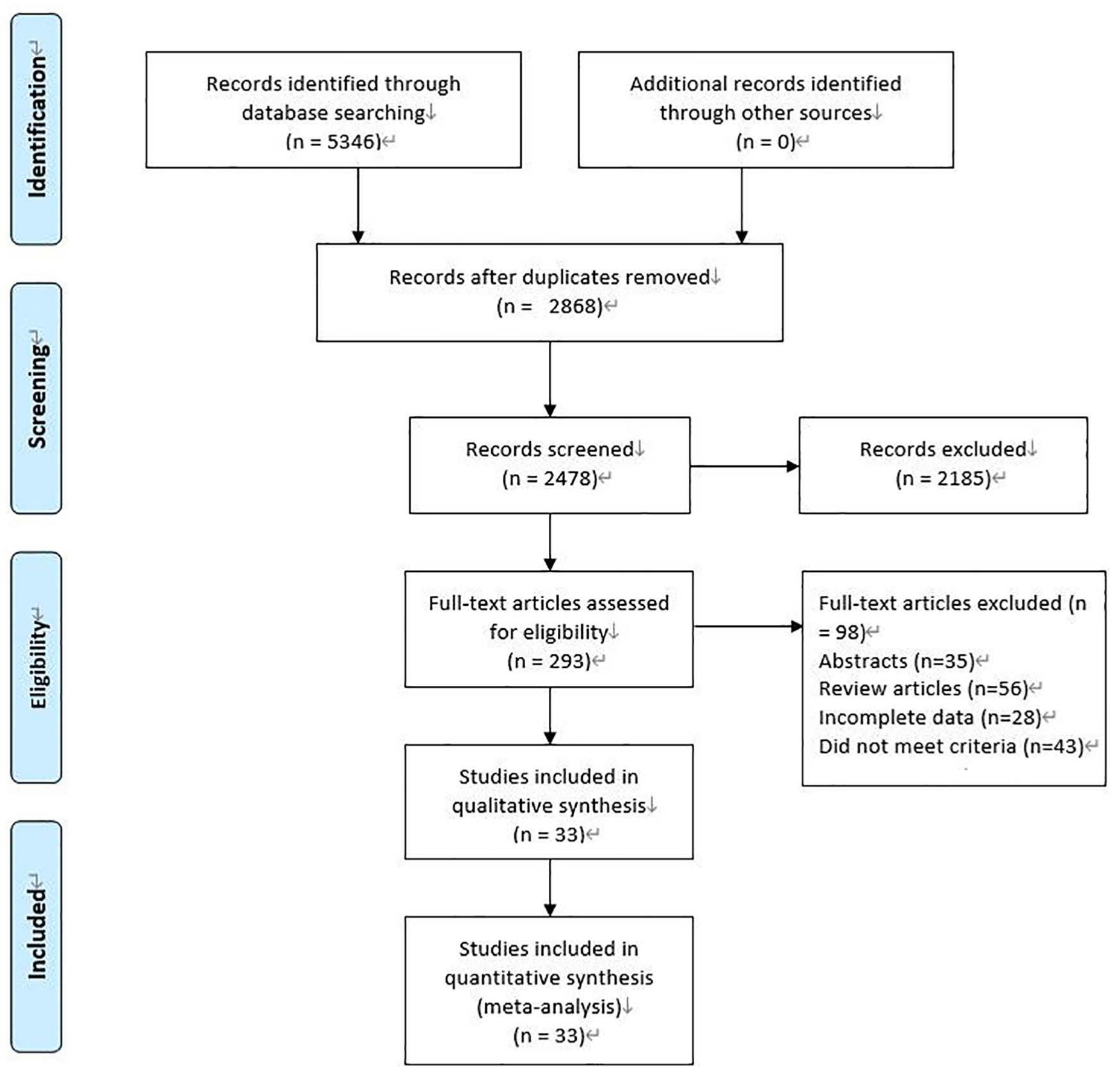



Figure 1. Flowchart for records selection process of the meta-analysis. (According to PRISMA template: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6 (7): e1000097. doi:10.1371/journal. Pmed 1000097).

### 2.3. Inclusion and exclusion criteria

We have included the literature by the following criteria. Comparative data were available on the treatment of mid and low rectal cancer through LaTME and TaTME. Outcome indexes should include at least one of the following, perioperative period, postoperative, and oncologic outcomes. Any study which did not confirm the above inclusion criteria was excluded.

### 2.4. Data extraction and outcome measures

Two researchers (L.D. and Y.L.) independently reviewed the retrieved literature by the inclusion and exclusion criteria. The third researcher (Z.Y.C) was asked to participate in the discussion to decide whether to include when disagreements were encountered. The extracted data included the first author, publication, country, study type, group, age, follow-up, Tumor height, and Tumor size (if mentioned) (Table 1).

### 2.5. Statistical analysis

Statistical analysis was performed by Stata v.12.0 (Stata Corp LLC, College Station, TX). For this meta-analysis, if the heterogeneity test was $I^2 > 50\%$, $P < .1$, we used the random effect model; if the heterogeneity test was $I^2 < 50\%$, $P > .1$, we used the fixed utility model. The combined $r$ values and 95% confidence intervals (CIs) of each study were calculated, and the forest map displayed the characteristics of each study result. The quality of the included literature was evaluated using the Newcastle–Ottawa scale (NOS). The Begg and Egger tests were used to test the publication bias. The $P < .05$ was indicated as statistically significant.

## 3. Results

### 3.1. Eligible studies and study characteristics

We initially searched 5346 records. 2868 literature that was published repeatedly and cross-published were deleted. After reading the title and abstract, 2185 articles were excluded. After the remaining 293 pieces of literature were searched for full text, reading, and quality assessment, 33 pieces of literature (8761 participants: LaTME: 5655 vs TaTME: 3106) were eventually included (Fig. 1: Guidelines Flow Diagram). The detailed information on this literature is listed in Table 1.

### 3.2. Perioperative outcomes

We included 17 studies[8–24] about operation time. Compared with TaTME, patients who underwent LaTME had no statistical difference (SMD −0.01; 95% CI: −0.07 to 0.05; $I^2 = 89.2\%$, $P = .679$). Owing to high heterogeneity ($I^2 = 89.2\%$), sensitivity

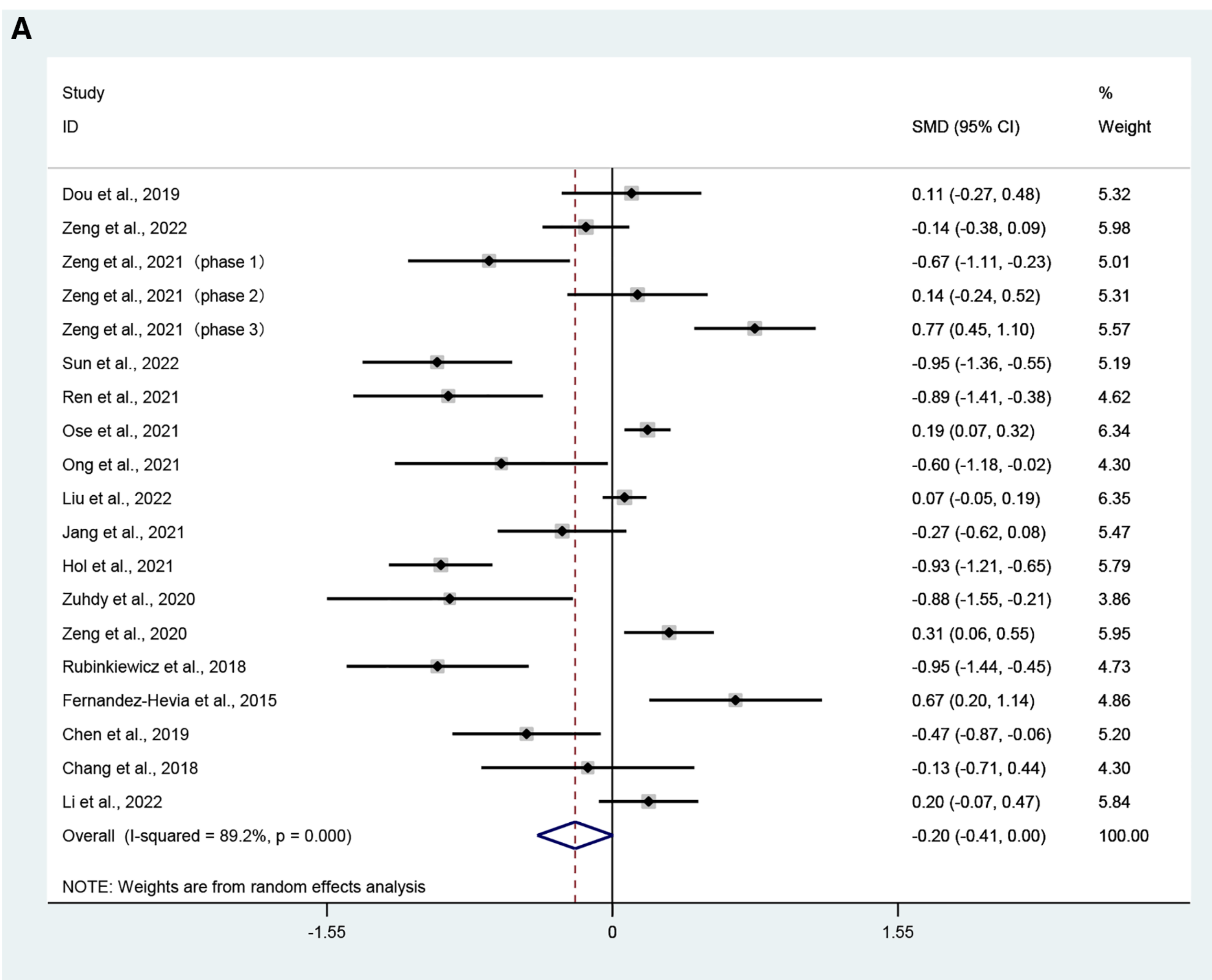
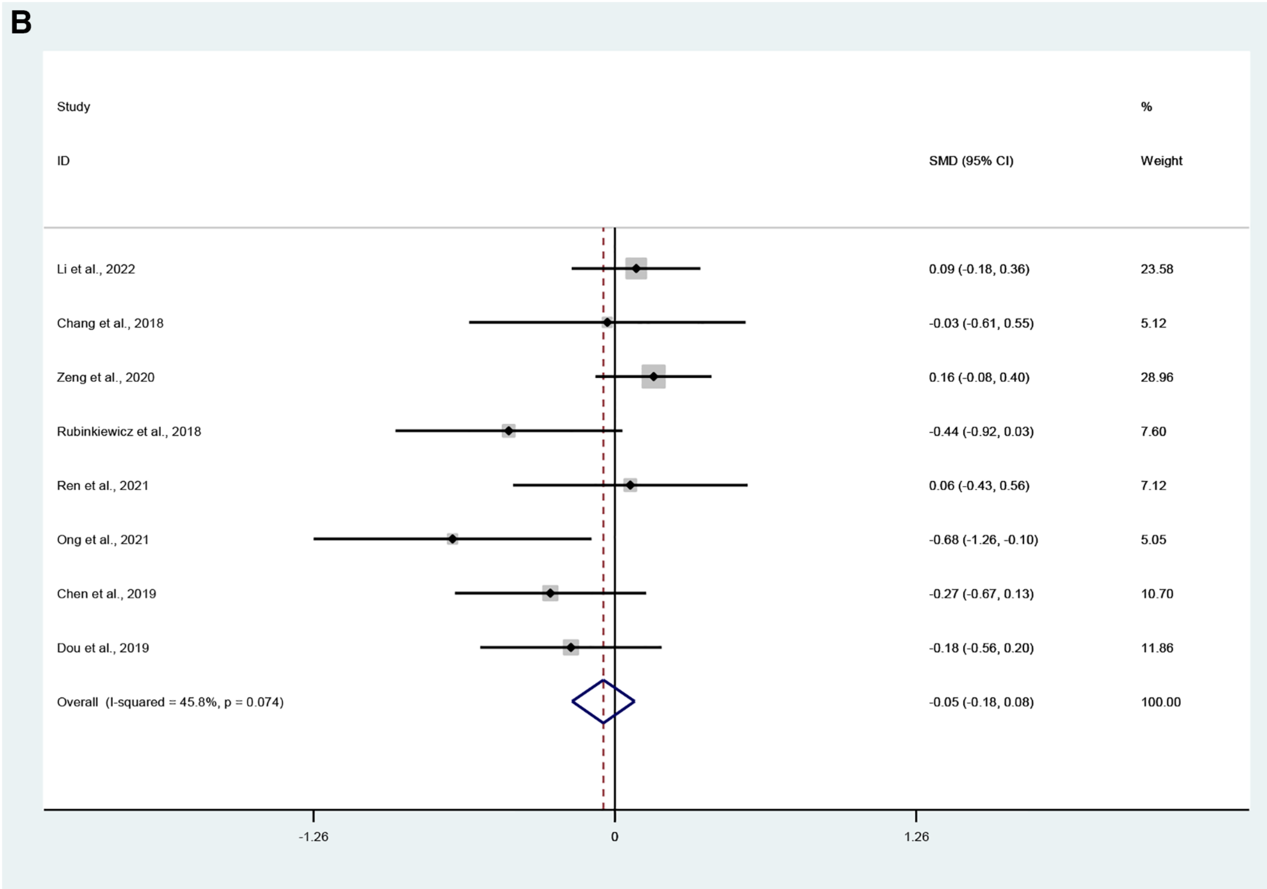



**Figure 2.** Meta-analysis of laparoscopic total mesorectal excision vs transanal total mesorectal excision for mid and low rectal cancer in A: operation time, B: estimated blood loss. C: postoperative hospital stay.



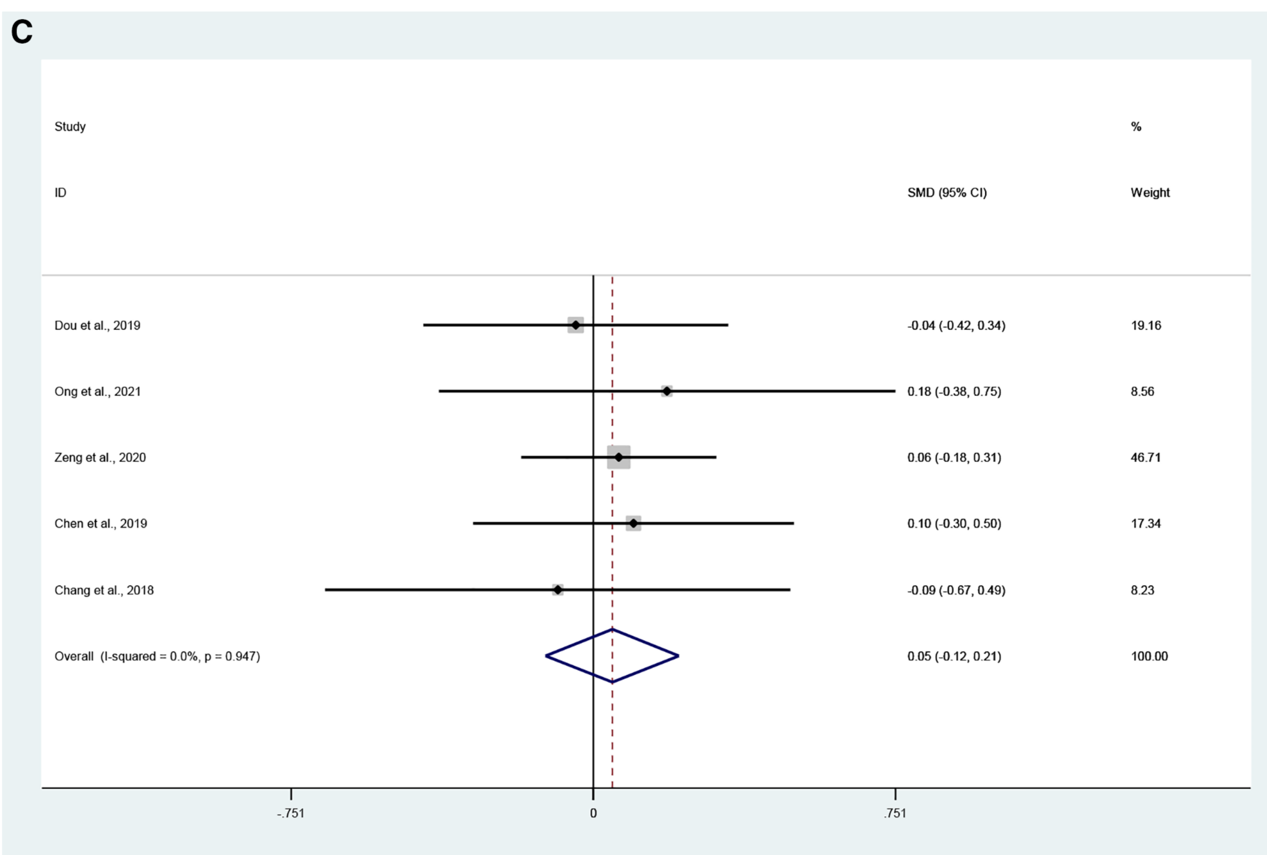




**Figure 2.** Continued

analysis cannot reduce heterogeneity. Therefore, we choose random effect model results (SMD −0.20; 95% CI: −0.41 to 0.00; $I^2$ = 89.2%, $P$ = .055) (Fig. 2A).

Data on EBL were reported in 9 studies.[8–10,14,16–19,23] Compared with TaTME, patients who underwent LaTME had no statistical difference (SMD 0.08; 95% CI: −0.01 to 0.17; $I^2$ = 60.4%, $P$ = .074). Owing to high heterogeneity ($I^2$ = 60.4%), sensitivity analysis was carried out by Stata 12.0. After removing the studies by Ose et al[17] as the sample that was "left out," the pooled results did change substantially but the heterogeneity was significantly reduced (SMD −0.05; 95% CI: −0.18 to 0.08; $I^2$ = 45.8%, $P$ = .474) (Fig. 2B). We included 5 studies[8–10,16,23] about postoperative hospital stay. Compared with TaTME, patients who underwent LaTME had no statistical difference (SMD 0.05; 95% CI: −0.12 to 0.21; $I^2$ = 0%, $P$ = .577) (Fig. 2C).

We included 15 studies[8,9,12,14,15,20,21,23,25–31] about over complications. Compared with TaTME, patients who underwent LaTME had no statistical difference (RR 0.96; 95% CI: 0.86–1.07; $I^2$ = 32.1%, $P$ = .418) (Fig. 3A). Compared with TaTME, patients who underwent LaTME had no statistical difference in intraoperative or postoperative complications (RR 0.92; 95% CI: 0.67–1.25; $I^2$ = 21.3%, $P$ = .582; RR 0.95; 95% CI: 0.81–1.10; $I^2$ = 24.8%, $P$ = .489) (Fig. 3B). Compared with TaTME, patients who underwent LaTME had less anastomotic leak rates (RR 0.82; 95% CI: 0.70–0.97; $I^2$ = 10.6%, $P$ = .019) (Fig. 3C), patients who underwent LaTME had no statistical difference in anastomotic stenosis (RR 1.01; 95% CI: 0.51–2.01; $I^2$ = 0%, $P$ = .979) (Fig. 3D), and patients who underwent LaTME had no statistical difference for wound infection (RR 1.01; 95% CI: 0.51–2.01; $I^2$ = 0%, $P$ = .979) (Fig. 3E).

We included 14 studies[14,15,19,21–23,25–27,31–34] about circumferential resection margin. Compared with TaTME, patients who underwent LaTME had no statistical difference (RR 1.18; 95% CI: 0.86–1.61; $I^2$ = 0%, $P$ = .304) (Fig. 4A). We included 7 studies[14,15,18,19,21,22,25] about distal resection margin. Compared with TaTME, patients who underwent LaTME had no statistical difference (RR 2.36; 95% CI: 1.00–5.59; $I^2$ = 0%, $P$ = .051) (Fig. 4B). Data on major low anterior resection syndrome were reported in 8 studies.[10,16,19,27,29,30,32,35] Compared with TaTME, patients who underwent LaTME had no statistical difference (RR 0.93; 95% CI: 0.76–1.14; $I^2$ = 0%, $P$ = .482) (Fig. 4C). Data on lymph node yield were reported in 5 studies.[8,9,16,18,20,31] Compared with TaTME, patients who underwent LaTME had no statistical difference (SMD 0.00; 95% CI: −0.17 to 0.18; $I^2$ = 29.4%, $P$ = .981) (Fig. 4D).

We included 2 studies[25,33] about loop ileostomy. Compared with TaTME, patients who underwent LaTME had no statistical difference (RR 0.88; 95% CI: 0.76–1.02; $I^2$ = 0%, $P$ = .917) (Fig. 5A). Data on end colostomy were reported in 3 studies.[12,25,33] Compared with LaTME, patients who underwent TaTME had less end colostomy. Owing to high heterogeneity ($I^2$ = 62.6%), sensitivity analysis was carried out by Stata 12.0. After removing the studies by Bedrikovetski et al[25] as the sample

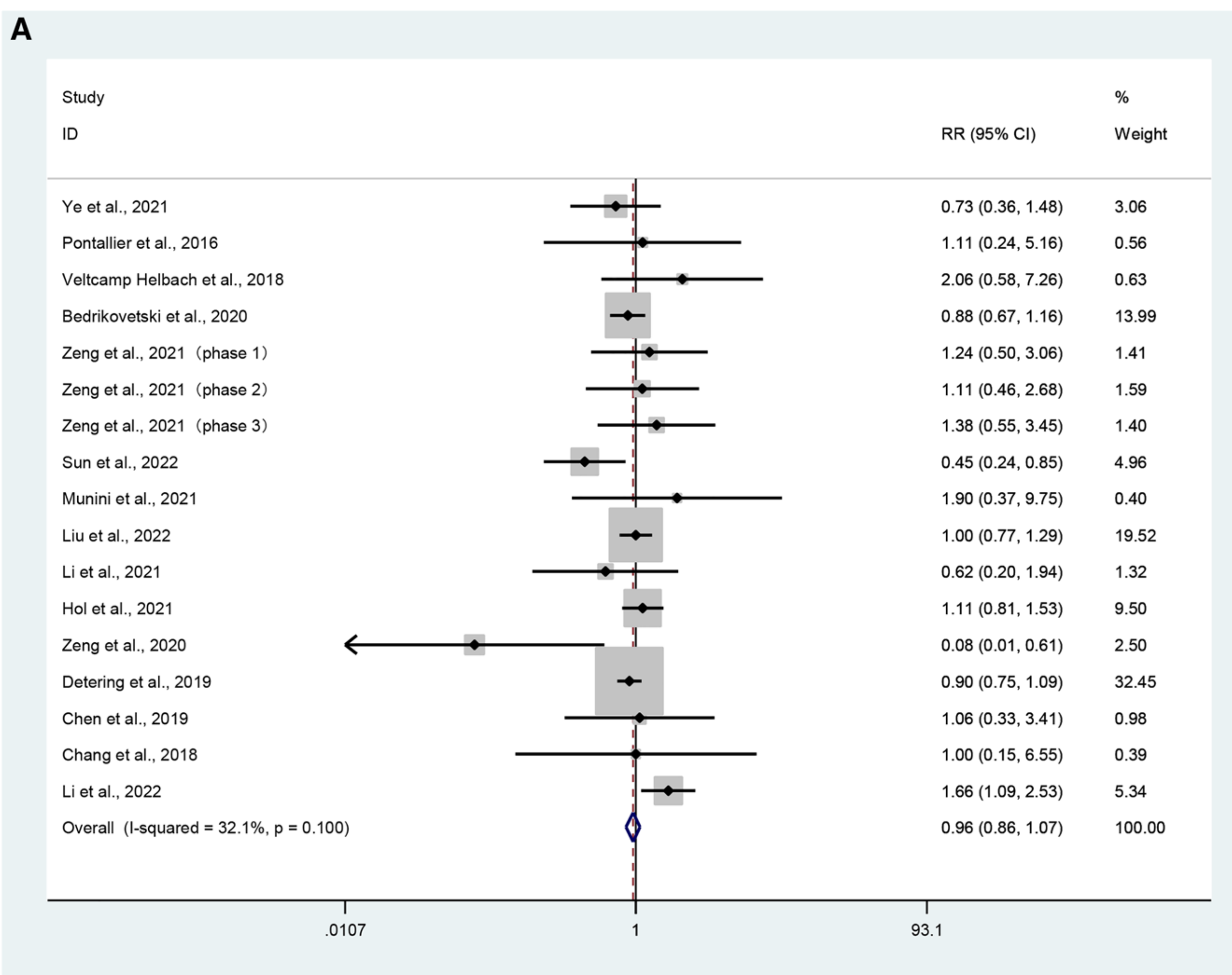
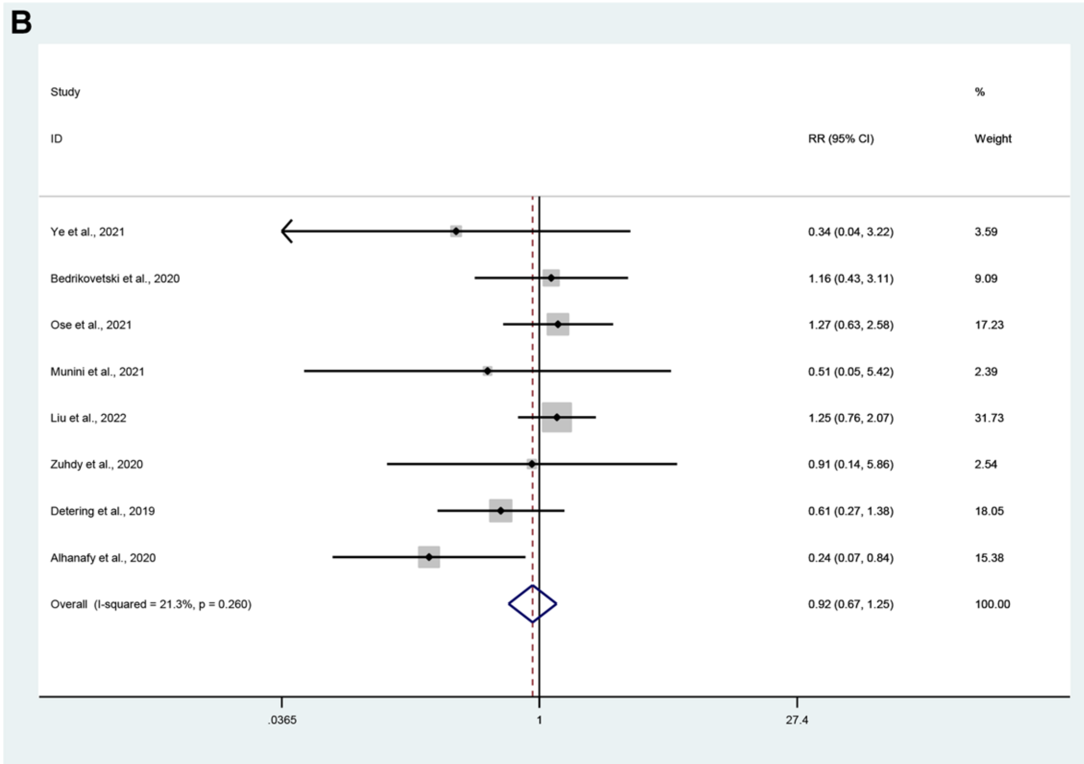



Figure 3. Meta-analysis of laparoscopic total mesorectal excision vs transanal total mesorectal excision for mid and low rectal cancer in A: over complications, B: intraoperative or postoperative complications, C: anastomotic leak rates, D: anastomotic stenosis, E: wound infection.



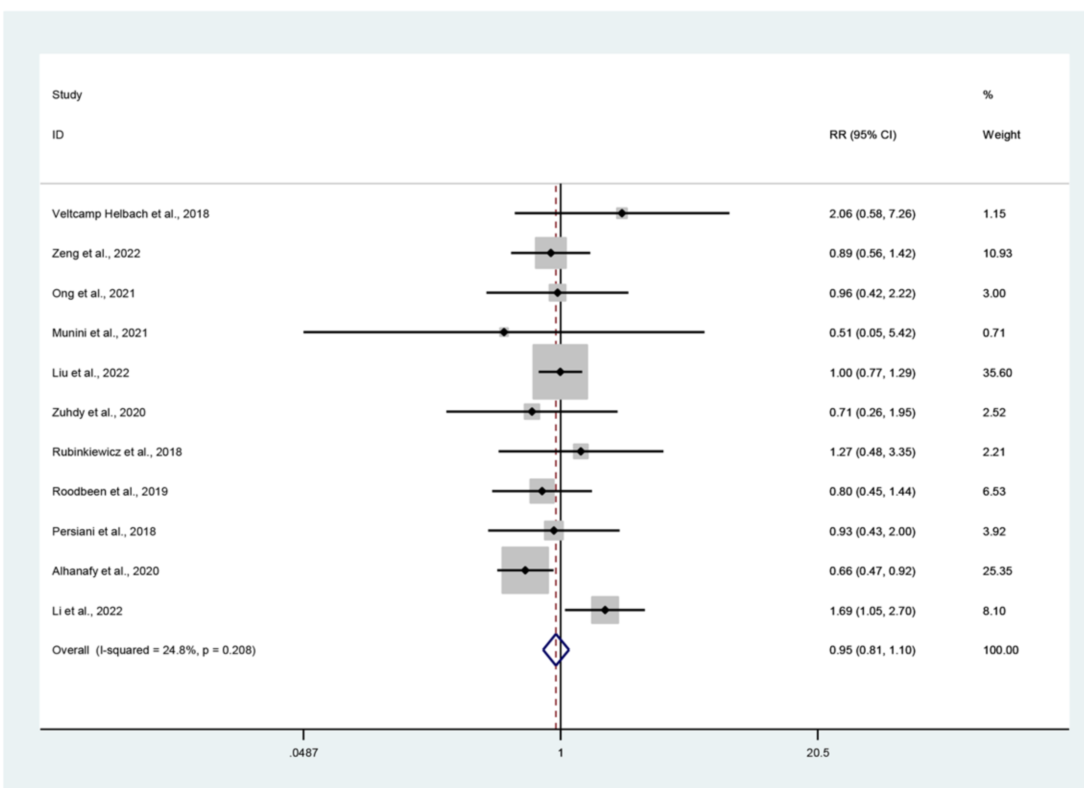




**Figure 3.** Continued

that was "left out," the pooled results did change substantially but the heterogeneity was significantly reduced (RR 1.96; 95% CI: 1.19–3.23; $I^2$ = 0%, $P$ = .008) (Fig. 5B). We included 3 studies[11,12,36] about diverting ileostomy. Compared with TaTME, patients who underwent LaTME had no statistical difference (RR 0.93; 95% CI: 0.81–1.07; $I^2$ = 0%, $P$ = .339) (Fig. 5C).

### 3.3. Oncological outcomes

Five studies recorded on 2-year disease-free survival (DFS) rate,[9,14,22,28,31] 5 studies recorded on 2-year overall survival rate,[9,14,22,31,33] 2 studies[31,33] recorded on distant metastasis, and 6 studies[9,14,22,28,31,33] recorded on local recurrence. There are

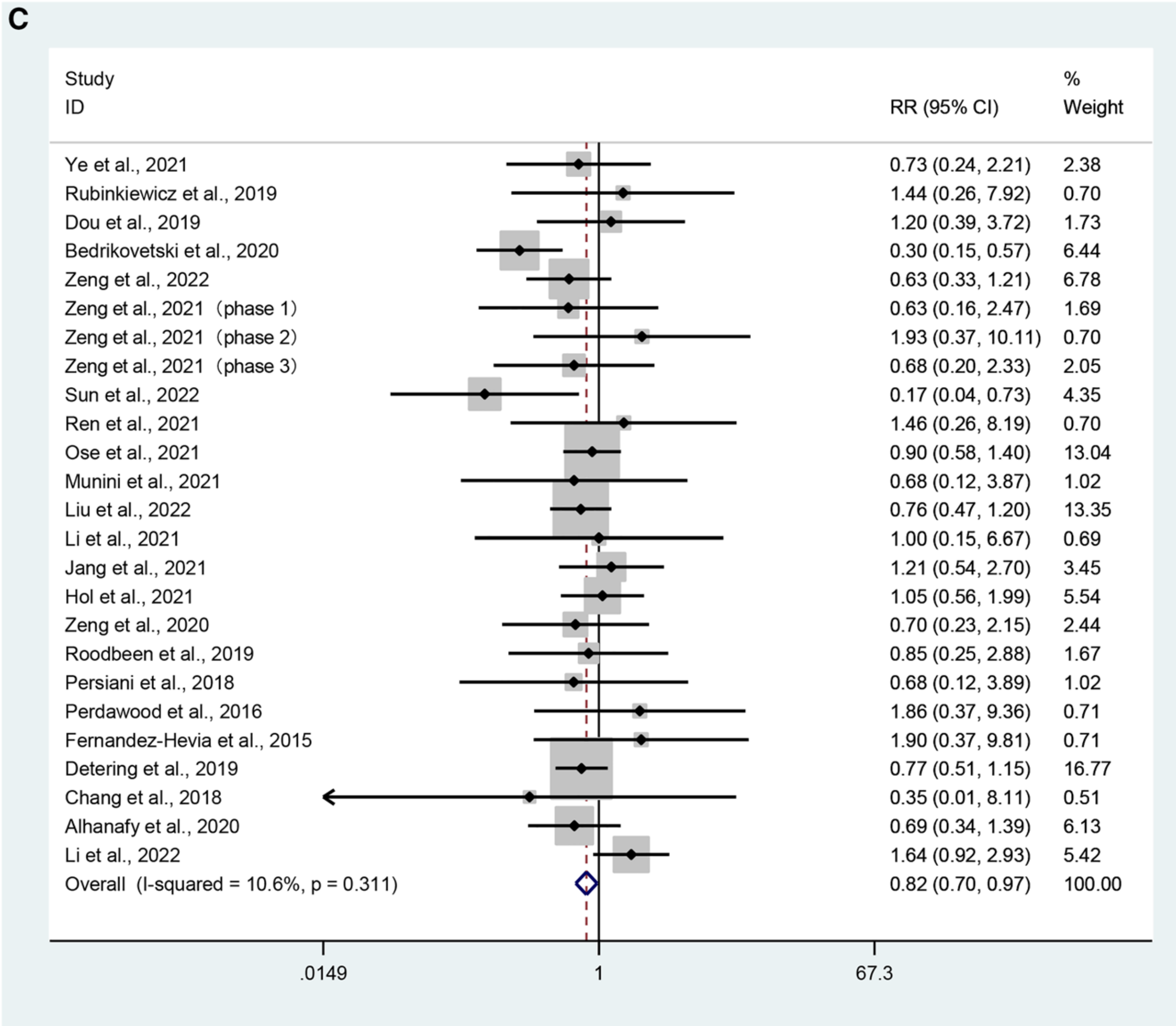



**Figure 3.** Continued

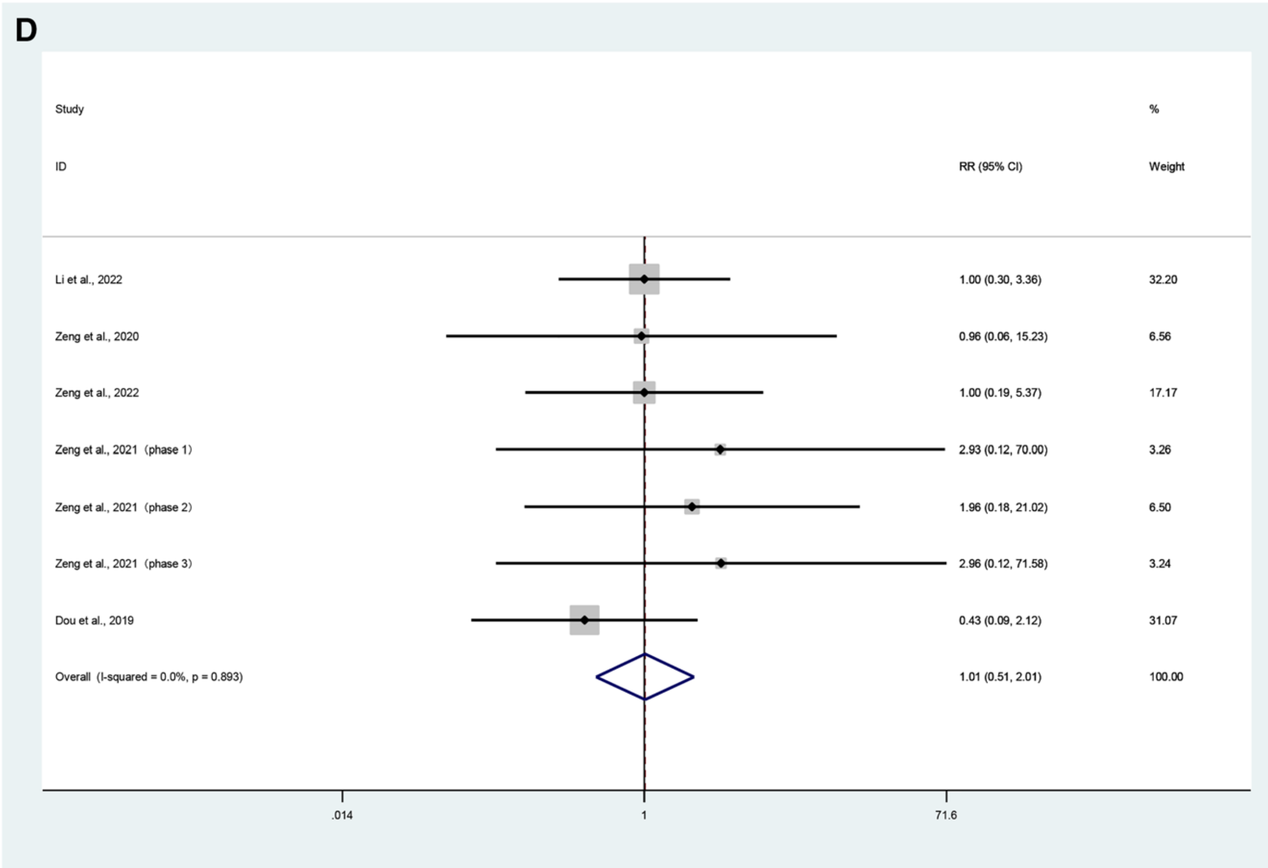
similarities between LaTME and TaTME for 2-year DFS rate (RR 0.99; 95% CI: 0.88–1.11; $I^2 = 0\%$, $P = .816$) (Fig. 6A), 2-year OS rate (RR 1.00; 95% CI: 0.90–1.11; $I^2 = 0\%$, $P = .969$) (Fig. 6B), distant metastasis rate (RR 0.47; 95% CI: 0.16–1.44; $I^2 = 0\%$, $P = .189$) (Fig. 6C), and local recurrence rate (RR 1.63; 95% CI: 0.78–3.41; $I^2 = 0\%$, $P = .197$) (Fig. 6D).

## 4. Publication bias

We conducted publication bias on more than 15 included studies using Begg test. For operation time, Begg test results revealed that $t = -1.99$, $P = .065$ in Figure S1A, Supplemental Digital Content, http://links.lww.com/MD/L292. For over complications. Begg test results revealed that t = 0.80, $P = .435$ in Figure S1B, Supplemental Digital Content, http://links.lww.com/MD/L293. There is no publication bias except circumferential resection margin in the above.

## 5. Discussion

The first application of TaTME to rectal cancer was reported by Sylla et al[37] in 2010. In the past decade, TaTME has made great progress. Colorectal surgeons around the world have been committed to exploring TaTME. With the establishment of the "International TaTME Registration Research Cooperation Group" by the University of Oxford in 2014, early research data showed that the integrity and near integrity of the mesorectum after TaTME surgery could reach 96%, while the positive rate of CRM was only 2.7%.[38] Recently, the positive rate of CRM published by the cooperation group was 4%.[39] However, a study in Norway showed that the local recurrence rate of tumors and the incidence of anastomotic leakage in TaTME patients were higher than the average level of matched cases. Therefore, Norway has issued an urgent appeal to stop TaTME surgery.[40] A study on MiTME versus TaTME for mid and low rectal cancer suggests that patients with MiTME who have a lower anastomotic leakage rate.[41] Our conclusion also confirms that Patients who underwent LaTME had less anastomotic leak rate. However, TaTME had less end colostomy. The possible reason is that the TaTME group has more hand-sewn anastomosis.[33] Completing TaTME surgery is difficult to operate and has a long learning curve. It is often necessary to deal with the tumor before disconnecting the blood vessels during surgery. The exploration of the abdominal cavity is limited. Laparoscopic or robotic TaTME is a combined anal and abdominal approach, which is relatively simple to operate and



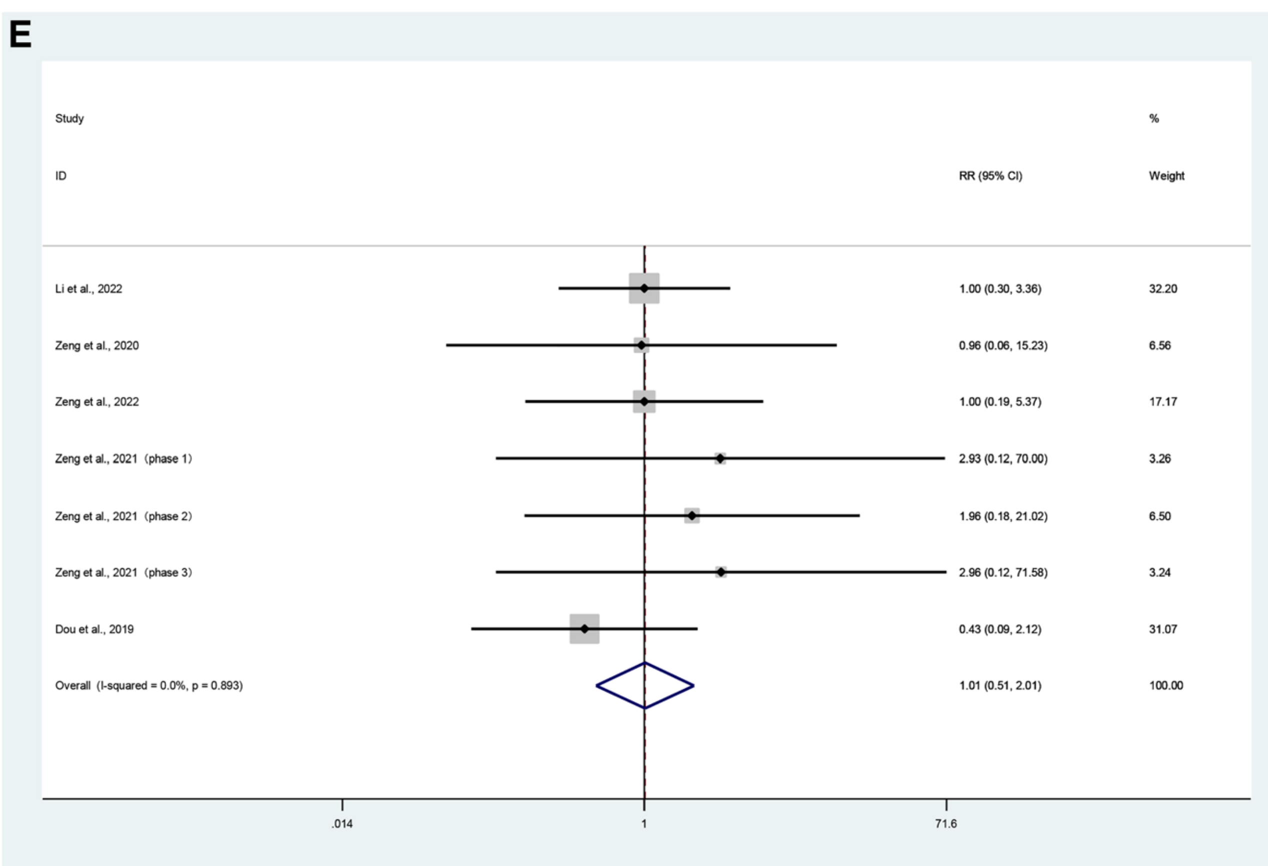




**Figure 3.** Continued

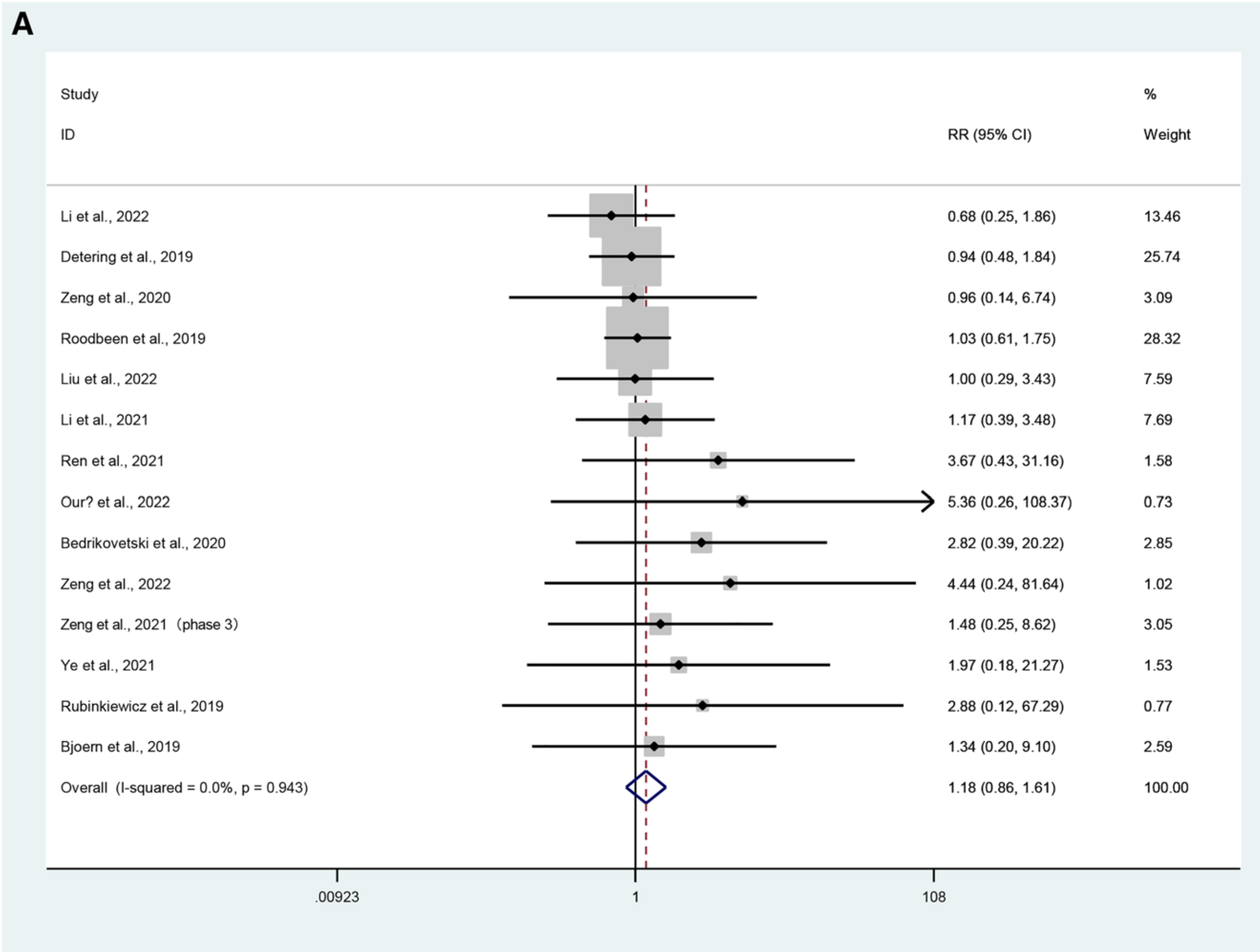



**Figure 4.** Meta-analysis of laparoscopic total mesorectal excision vs transanal total mesorectal excision for mid and low rectal cancer in A: circumferential resection margin, B: distal resection margin, C: major low anterior resection syndrome, D: lymph node yield.

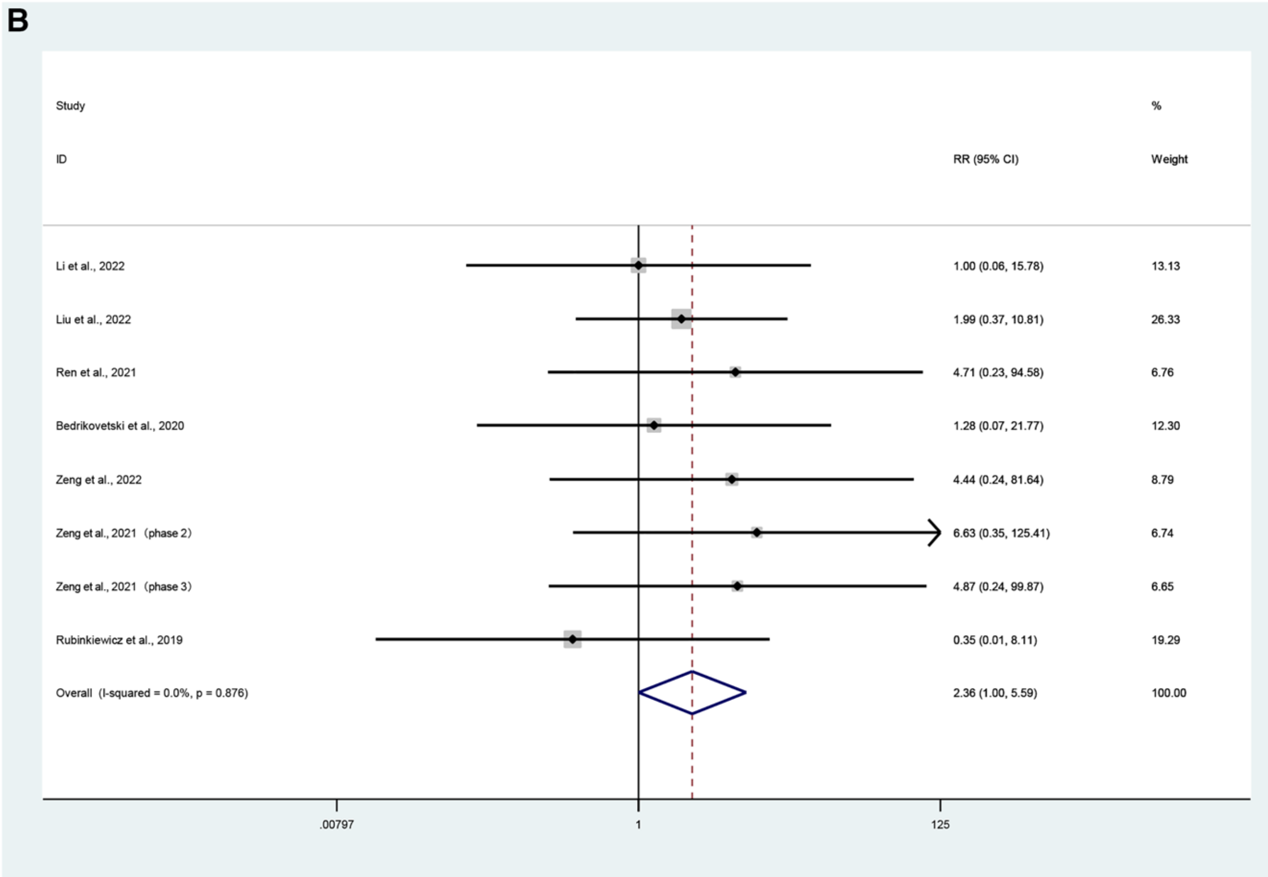
has a short learning curve. It is worth promoting in clinical practice.[17,42] Given the current disputes between TaTME and LaTME on the positive rate of CRM, the integrity of mesorectum, and postoperative anastomotic leakage, some scholars have explored evidence-based medicine using the method of meta-analysis. However, some of the results of the published meta-analysis studies are quite different.[43–47] By reading and analyzing multiple literature related to this study, the following points may be the reasons for inconsistent meta-analysis results: The quantity and quality of the included literature. In the early studies, such as Xu, Ma, etc.,[44,45] only 7 studies were included, and the number of cases in the same group reported in some literature was small. The general characteristics of the cases included in the literature vary. For the TaTME operation, male patients, obesity, the distance from the lower edge of the tumor to the anal margin, and whether new adjuvant therapy is used are important factors that affect the outcome analysis indicators. The outcome indicators of some studies are too few to explain the conclusions. Inappropriate choice of analysis model and no further search for the source or description of outcome heterogeneity.

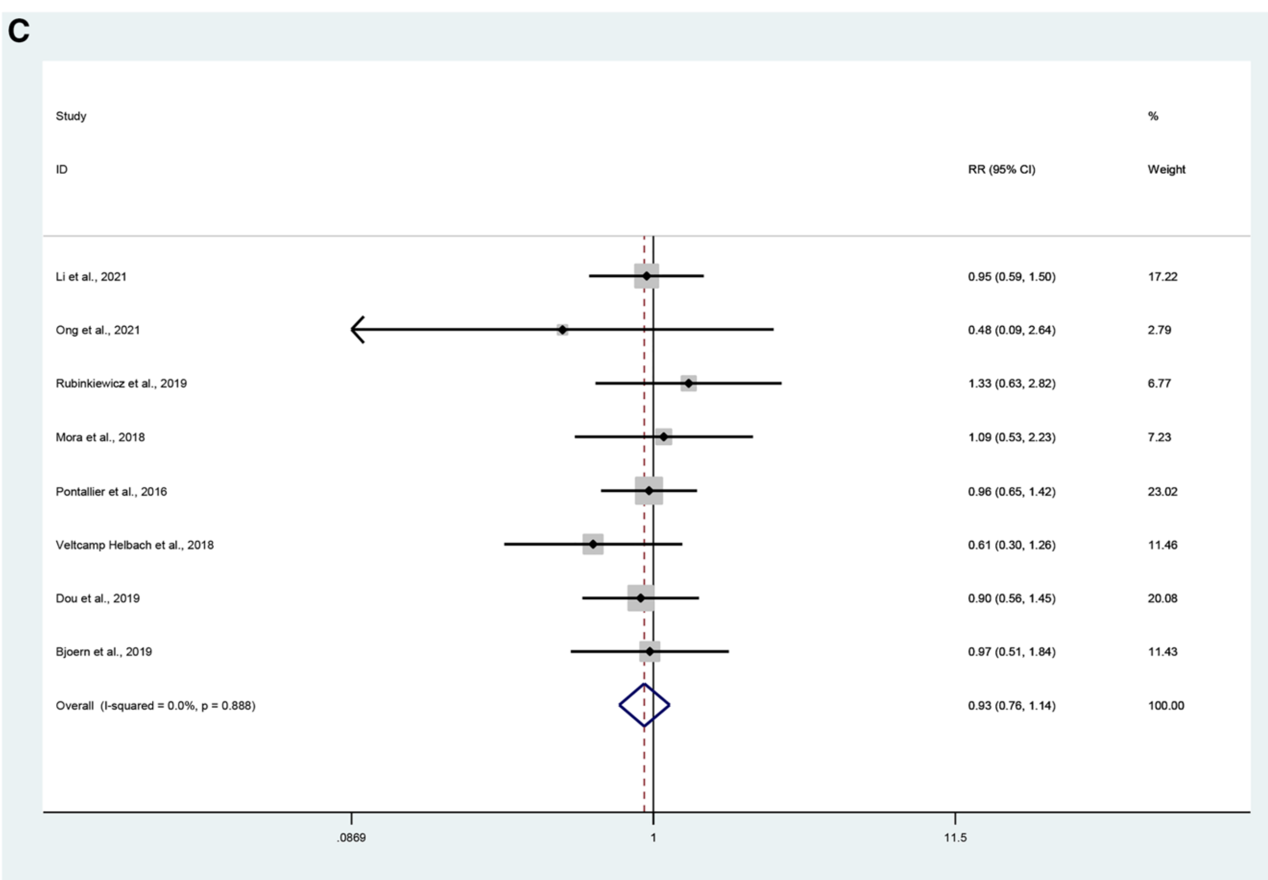
In terms of long-term effects after surgery, this study analyzed that there was no statistical difference between the 2 groups in local recurrence, distant metastasis, 2-year DFS, and 2-year OS. And the results were stable. The local recurrence rate was included in 6 articles, but no subgroup analysis of follow-up time was carried out for them, while 2-year DFS and OS were only included in 5 articles, so the long-term effect of the 2 groups needs further research.

Of course, our research also has some limitations: The included studies are retrospective studies or prospective cohort studies, which will inevitably be affected by selection bias. In terms of the baseline report of the cases included in the literature, only some of them were provided. Of course, we analyzed the baseline data that can be extracted from the included literature, but we still lacked the comprehensiveness of the data, and could not conduct subgroup analysis according to general characteristics, such as male-female ratio, BMI value, etc. In the data analysis, although we conducted a sensitivity analysis on highly heterogeneous outcome indicators, some results did not identify the source of their heterogeneity. In terms of analysis indicators, the long-term efficacy, such as local tumor recurrence rate, was not analyzed by subgroup according to the follow-up time, while only 5 articles were included in the 2-year DFS and 2-year OS, and the number of articles included in the analysis was insufficient. At present, the follow-up time of various studies is limited, and not enough long-term efficacy data is provided for analysis. In terms of functional outcome data, only kinds of literature mention it and it is not uniformly quantified, which causes certain difficulties in analysis.

## 6. Conclusion

This study comprehensively and systematically evaluated the differences in safety and effectiveness between LaTME and

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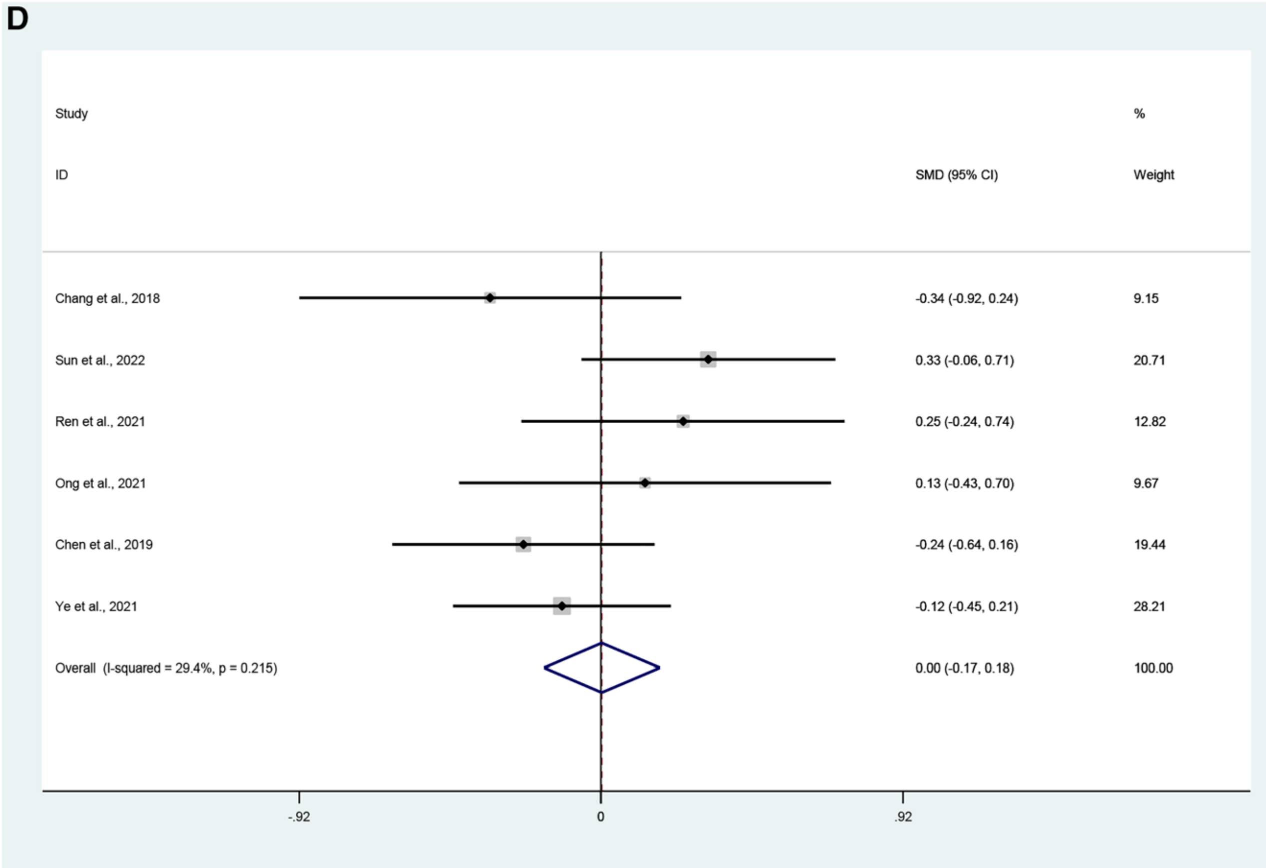


**Figure 4.** Continued

TaTME in the treatment of mid and low rectal cancer through meta-analysis. Patients who underwent LaTME had less anastomotic leak rate but TaTME had less end colostomy. There is no difference in other aspects. Of course, in the future, more scientific and rigorous conclusions need to be drawn from multicenter RCT research.

## Author contributions

**Conceptualization:** Zhang De Chun.
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**Methodology:** Feng Xiao Li, Ran Dan.
**Project administration:** Lin Dong.
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**Software:** Lu Ya, Liu Yang, Luo Yi, Lin Dong.
**Validation:** Ou Gang, Du Yong Gang, Liu Xin, Zhang Peng, Luo Yi.
**Visualization:** Zhou Zhijun.
**Writing – original draft:** Liu Yang, Lin Dong.
**Writing – review & editing:** Ran Dan, Lin Dong.

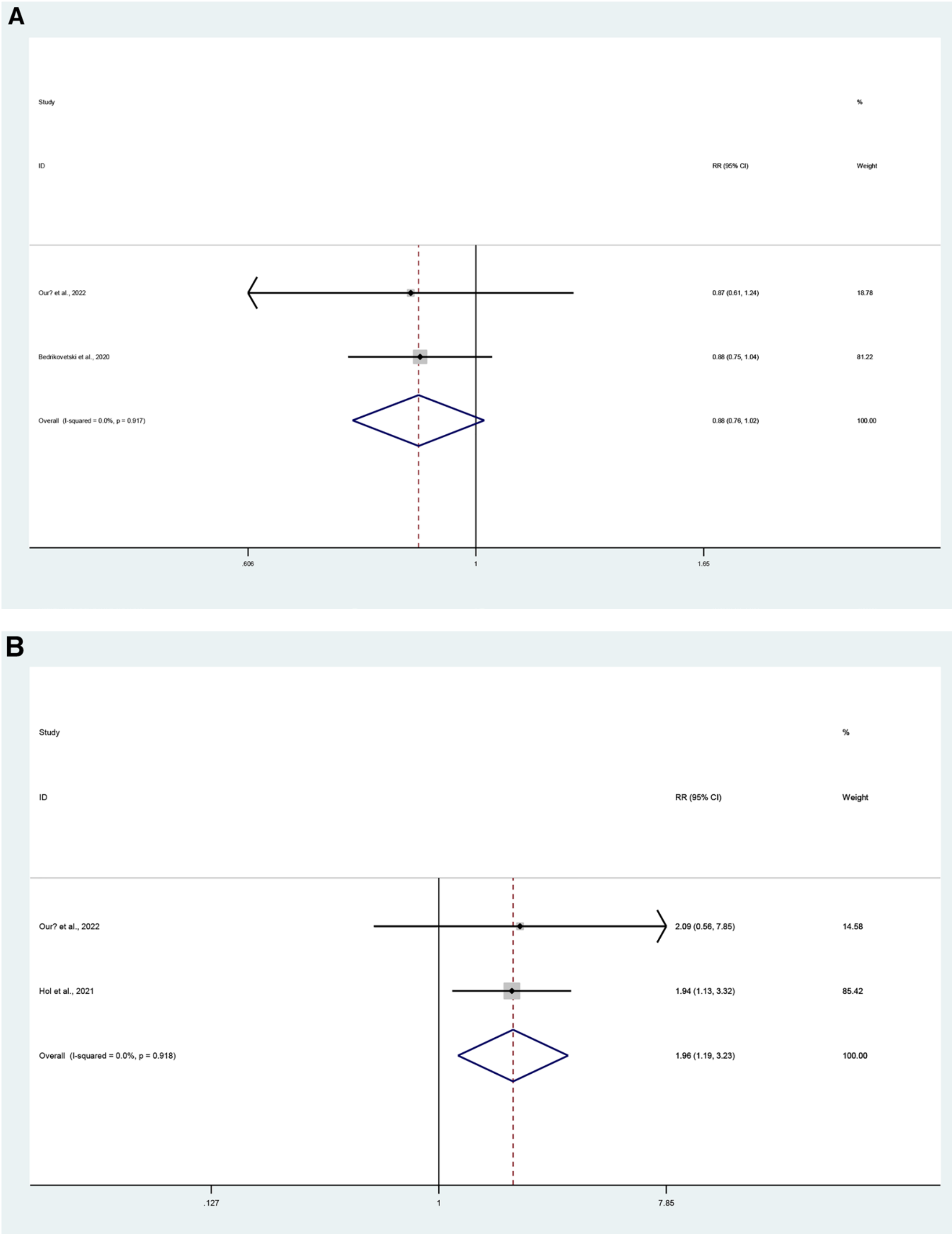
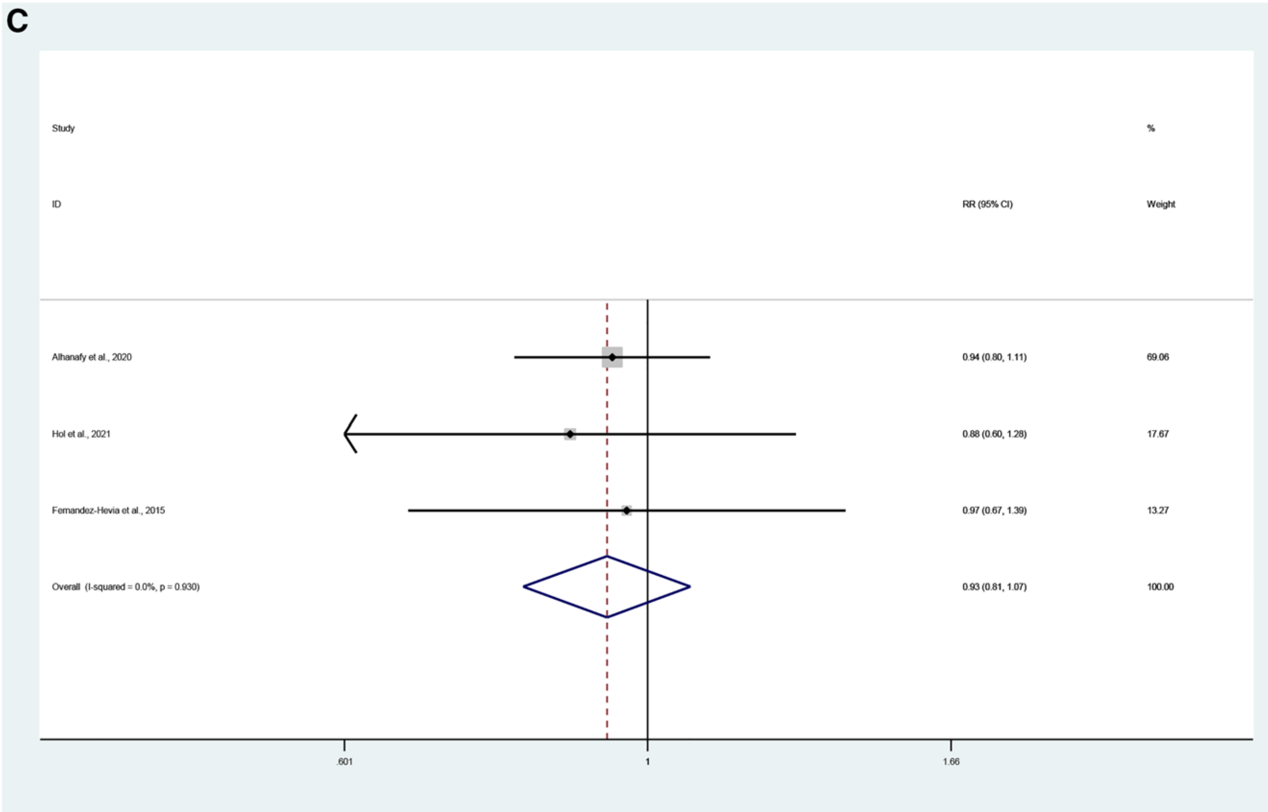



**Figure 5.** Meta-analysis of laparoscopic total mesorectal excision vs transanal total mesorectal excision for mid and low rectal cancer in A: loop ileostomy. B: end colostomy. C: diverting ileostomy.

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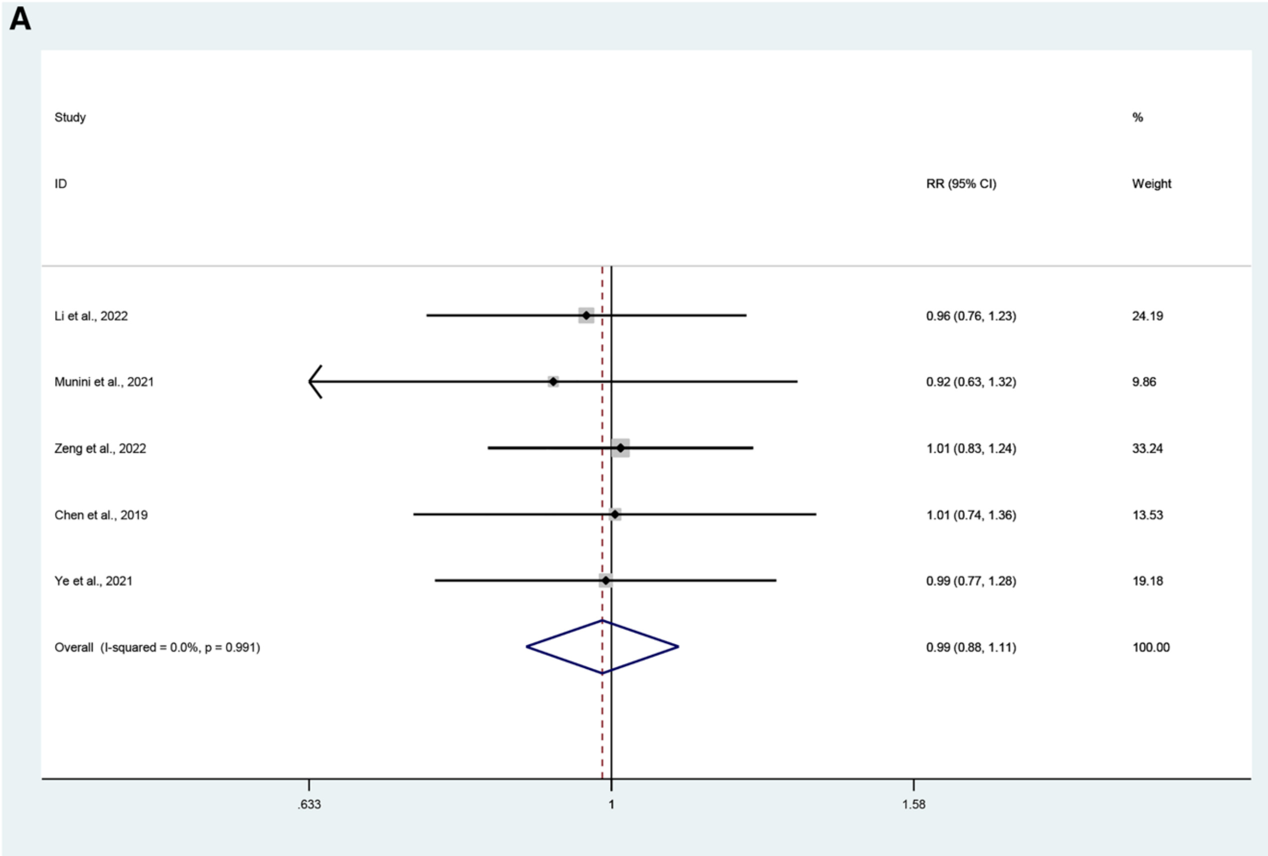
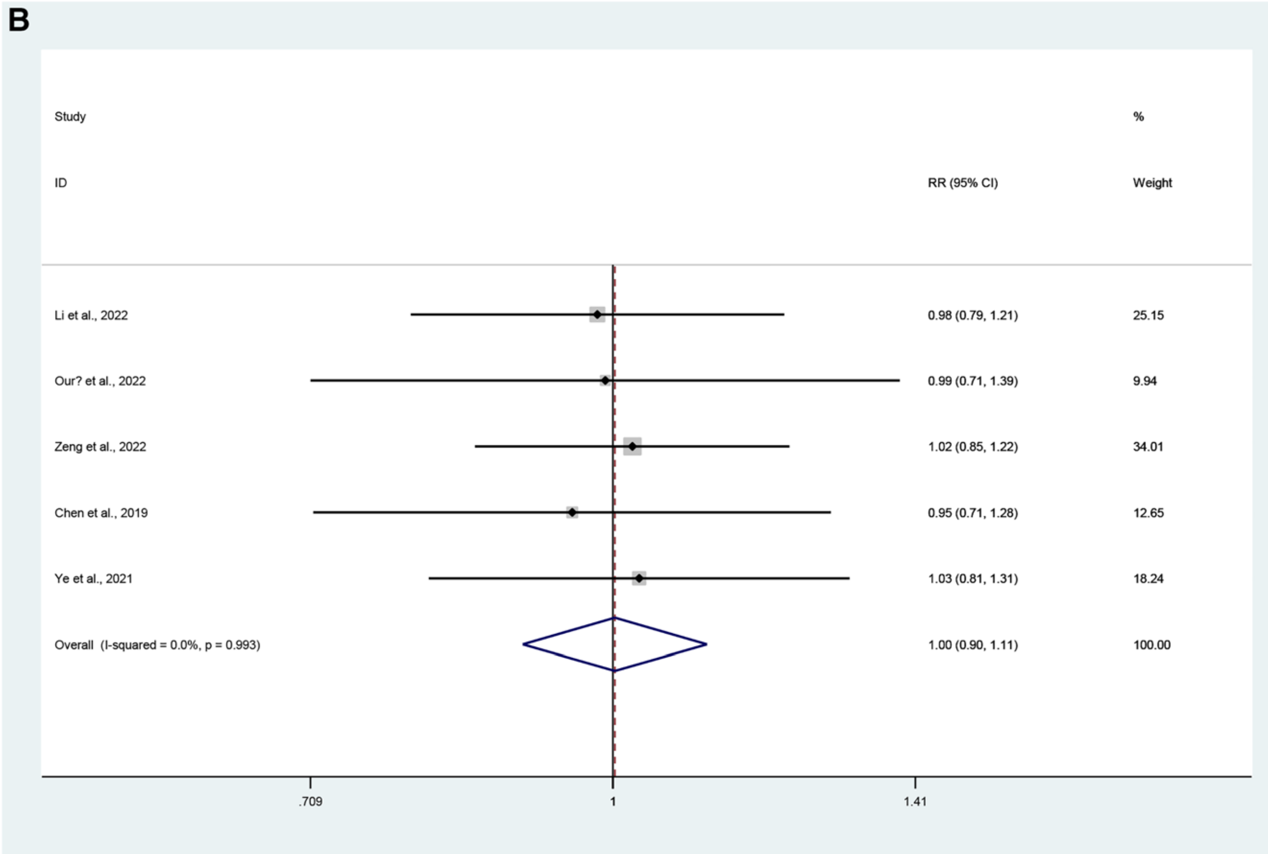
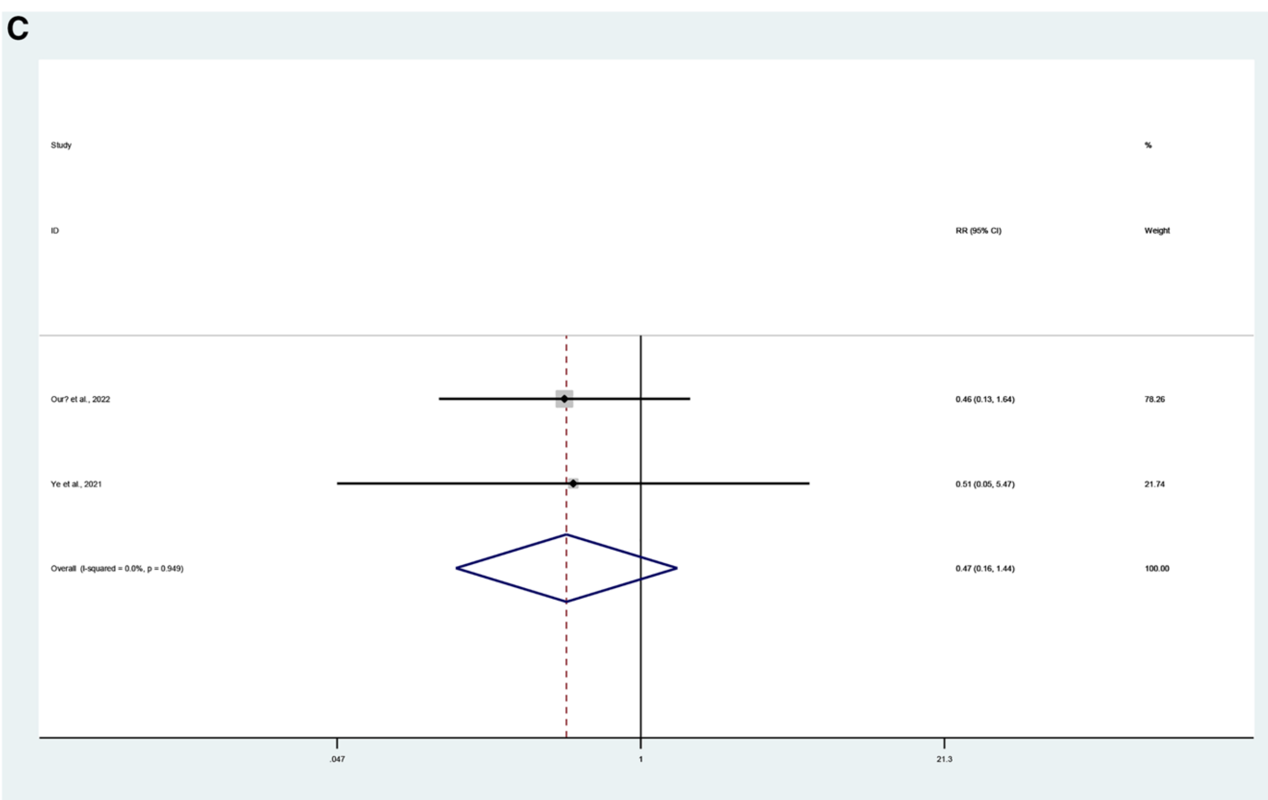



**Figure 6.** Meta-analysis of laparoscopic total mesorectal excision vs transanal total mesorectal excision for mid and low rectal cancer in A: 2-year DFS rate, B: 2-year OS rate, C: distant metastasis rate, and D: local recurrence rate.

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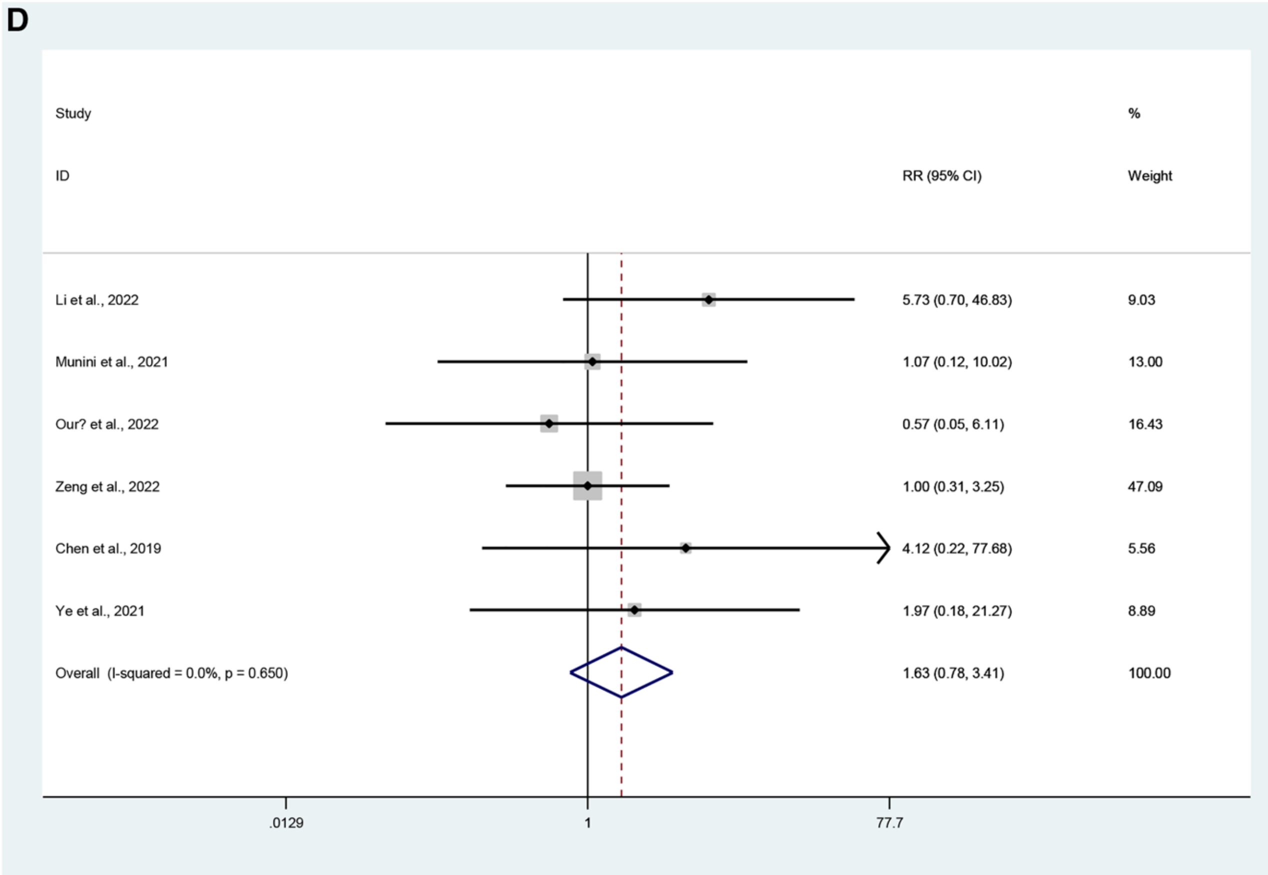


**Figure 6.** Continued

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