Comparison between the Extraperitoneal Route with the Transperitoneal Route for the Permanent Colostomy: A Meta-Analysis with Rcts and Systematic Review

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Abstract

Aim

To assess the efficacy of extraperitoneal colostomy(EPC) in the prevention of stoma-related complications.

Background

Transperitoneal colostomy (TPC) is still a widely used surgical approach. However, TPC has been reported with highly incidence of stoma-related complications, like parastomal hernia, stomal retraction, stomal prolapse.The purpose of EPC is to prevent these complications. But it is still lack of evidence-based basis.

Material and methods

MEDLINE, EMBASE, Web of Science, Scopus, MOOSE, Pubmed, Google Scholar, Baidu Scholar, and the Cochrane Library were searched to conduct a systematic review and meta-analysis with RCTs. Revman 5.4 was performed in the meta-analysis.

Results

A total of 5 RCTs were eligible in this study. Compared with TPC, EPC group had lower incidence in Parastomal Hernia (RR, 0.14; 95% CI, 0.04–0.52, P=0.003, I^2=0%), Stomal Prolapse (RR, 0.27; 95% CI, 0.08–0.95, P=0.04, I^2=0%) and a higher rate of defaecation Sensation (RR, 3.51; 95% CI, 2.47–5.0, P<0.00001, I^2=37%). No statistical difference was observed in Stoma Retraction, Colostomy Construction Time, Stoma Ischemia, and Necrosis.

Conclusion

An extraperitoneal colostomy is associated with a lower rate of postoperative complication compared to transperitoneal colostomy. Randomized controlled trial meta-analysis showed better results in permanent colostomy after abdominoperineal resection.

Background

Abdominoperineal resection with a permanent colostomy is still a standard procedure for patients with low rectal cancer surgery[1]. Traditionally, a permanent stoma is constructed using the transperitoneal colostomy(TPC). However, TPC is associated with a higher incidence of stoma-related complications, such as parastomal hernia, stomal retraction, stomal prolapse, and stoma-related blood supply disorder[2]. It's been reported that the overall incidence of parastomal hernia is up to 50% or even higher in a long-term follow-up[3]. Although many complications are asymptomatic, may cause discomfort to life-threatening problems[4]. The extraperitoneal approach for stoma construction, which was firstly reported by Goligher has been considered effective to decrease the rate of parastomal hernia and small bowel obstruction[5]. Further, Hamada *et al* developed a laparoscopic technique to create colostomy through the extraperitoneal route and found an effective way to reduce the incidence of parastomal hernia[6]. Jin *et al*. [7] reported a lower long-term stoma-related complications in the EPC group. However, the subsequent studies have been published with inconsistent results. The efficacy of EPC in permanent colostomy still remains controversial in available studies.

Therefore, this meta-analysisaimed to compare the effectiveness of extraperitoneal versus transperitoneal colostomy withrandomcontrolled trails(RCTs).

Materials And Methods

All aspects of the Preferred Items for Reporting of Systematic Reviews and Meta-analyses (PRISMA) statement[8] and Meta-analysis of Observational Studies in Epidemiology (MOOSE) guideline[9] were followed.

Search Strategy and Data collection

A systematic search of the main medical database, MEDLINE, EMBASE, Web of Science, Scopus, MOOSE, Pubmed, Google Scholar, Baidu Scholar, and the Cochrane Library using the interchangeable terms “extraperitoneal”, “transperitoneal”, “transperitoneal”, “rectal cancer”, “laparoscopic abdominoperineal resection”, “parastomal hernia”, “colostomy” “sigmoidoscopy”, “stoma or ostomy”, and related Medical Subject Headings. We searched all studies published from 2008 to now. We manually searched references of the retrieved articles as well as identify additional published articles.

Two authors(Jinlong Luo and Dujanand Singh) separately read the titles of the identified references and excluded irrelevant studies. The final evaluation was done independently based upon an examination of the full text. The inclusion criteria were RCT studies that include the outcomes of both extraperitoneal colostomy and transperitoneal colostomy, having completely published papers. The topic-related studies that evaluated at least one of these interesting outcomes - Parastomal Hernia, Stomal Prolapse, Stomal Retraction, Stomal Ischemia and Necrosis, Colostomy Construction

Time, and Defaecation Sensation Data of these articles were independently extracted by two researchers. We resolved conflicts of interest by discussing and consulting a third reviewer.

Assessment of Study Quality

The possible risk of bias was assessed using the Cochrane Collaboration's risk for a bias assessment tool[10]. Two reviewers assessed the quality of the studies, and disagreements were discussed with a third researcher.

Statistical analysis

Revman software (version 5.4; The Nordic Cochrane Centre, Copenhagen, Denmark) was used to perform the meta-analysis. Risk ratios (RRs) and 95% confidence intervals (CIs) were used to compare the variables of Parastomal Hernia, Stomal Prolapse, Stoma Retraction, Stoma Ischemia, and Necrosis, and Defaecation Sensation. Mean Differences (MD) were was used to analyze the Colostomy Construction Time. The I^2 statistic was performed to assess statistical heterogeneity, and we considered an I^2 of 0–40% as probably not important, 30–60% as representing moderate heterogeneity, 50–90% as substantial heterogeneity, and 75–100% as considerable heterogeneity. A random-effects model was used if clinical heterogeneity was noted during the study, while and a fixed-effects model was used if heterogeneity was low. We planned to explore heterogeneity and perform a subgroup analysis if appropriate. Significance was set at P = 0.05 in both models.

Results

Description of eligible studies

We identified 593 studies from the database search and other sources. A flow diagram is used to identify eligible studies (Fig. 1). A total of 5 articles were selected that included 417 patients (211 patients in the extraperitoneal group, 207 patients in the transperitoneal group). Among those patients, 311patientsperformedlaparoscopic surgery, while 106 patients under went open surgery. There were all from China. Basic study characteristics are summarized in Table 1. The assessment of the risk of bias assessment is presented in Fig. 2.

Table 1
Characteristics of the studies included in the meta-analysis.

Reference	Primarysurgery	Follow-up, mo	Patients (EPC/TPC)	Parastomal hernia (EPC/TPC)	Stoma prolapse (EPC/TPC)	Stoma retraction (EPC/TPC)	Stoma ischemia and necrosis (EPC/TPC)	Defaecation sense (EPC/TPC)	Operating time, min (EPC/TPC)
Wu *et al.2017*	OAPR	12	53/53	0/3	0/3	0/1	1/1	-	22.8 ± 2.4/16.4 ± 1.5
Ye*et al.2014*	LAPR	6–36	41/40	0/3	1/1	0/1	1/2	38/11	-
Zhou*et al. 2016*	LAPR	1–12	33/34	0/4	0/2	0/2	0/2	11/6	13.4 ± 1.7/16.4 ± 2.6
Jin *et al. 2014*	LAPR	12–24	18/18	0/2	0/1	0/0	1/1	-	25.3 ± 8.5/14.7 ± 6.4
Dong *et al. 2012*	LAPR	6–60	66/62	0/5	0/2	1/3	1/1	51/10	21.3 ± 3.5/30.4 ± 4.2
OAPR = Open abdominoperineal resection; LAPR = Laparoscopic abdominoperineal resection; EPC = Extraperineal colostomy; TPC = Transperineal colostomy.									
Operating time = Colostomy construction time.									

Parastomal Hernia

All five included studies[11–15] with a total of 420 patients (213 patients with EPC and 207 patients with TPC) reported on a parastomal hernia. In our analysis (Fig. 3), the parastomal hernia rate was statistically lower in the extraperitoneal route using a laparoscopic approach RR, 0.14; 95% CI, 0.04–0.52, P = 0.003, I^2 = 0%).

Stomal Prolapse

Five studies[11–15], of 418 patients (211 patients with EPC and 207 patients with TPC) reported stomal retraction (Fig. 4). The analysis was associated with a lower incidence of stomal prolapse in the extraperitoneal route (RR, 0.27; 95% CI, 0.08–0.95, P = 0.04, I^2 = 0%).

Stomal Retraction

Four studies[11, 13–15] were reported a lower rate of stomal retraction in the EPC group, but the difference did not reach statistical significance (RR, 0.29; 95% CI, 0.07–1.16, P = 0.08, I^2 = 0%) (Fig. 5).

Stomal Ischemia and Necrosis

Among the four included studies, two papers were reported on stomal ischemia[11–13]. One paper reported on stoma necrosis[15], and one on compromised stoma blood supply[14]. Because the avascular ischemia and necrosis are all caused by blood supply disorder, we put the data together. The pooled data showed no statistical difference (RR, 0.47; 95% CI, 0.14–1.60, P = 0.23, I^2 = 0%) (Fig. 6).

Sensation of Defecation

Three studies[11, 14, 15] reported on defecation sensation. All these studies showed a high sensation of defecation in the extraperitoneal group of studies and statically significant (RR, 3.51; 95% CI, 2.47–5.0, P<0.00001). A random-effects model was used to validate the results (I^2 = 78%) (Fig. 7). Heterogeneitydecrease by excluding the study reported by Zhou[15], and we have the same result that extraperitoneal associated with a high rate of sensation (RR, 18.15; 95% CI, 8.95–36.78, P<0.00001).

Colostomy Construction Time

Four studies[11–13, 15] reported on colostomy construction time. Two studies[11, 15] were statistically significant for a shorter time of colostomy construction in the extraperitoneal group. One study[12] reported statistical significance for longer colostomy construction time in the extraperitoneal group. While one study[14] showed no significant difference in both groups. Our analysis showed that there is no statistically significant difference regarding the construction time (MD, -0.18; 95% CI, -9.63–9.26, P = 0.97, I2 = 100%)(Fig. 8) .

Discussion

Stoma-related complications include parastomal hernia, prolapse, retraction, ischemia, and necrosis. These are barely avoidable issues[15–17]. EPC is designed to reduce the incidence of stoma-related complications. Studies suggested extraperitoneal colostomy has beneficial effects with fewer complications [6, 18], However, it still lacks evidence-based medical evidence. We included five RCTs to evaluate two distinct operative methods to create permanent colostomy and assess the effectiveness of colostomy for a better outcome.

Parastomal hernia

Parastomal hernia is the most common complication following permanent stoma formation[16]. The incidence of parastomal hernia varies widely inliterature, it develops most commonly in the first 2 years after stoma formation, with an incidence of up to 50%, and the risk persists for more than 20 years[17, 18].Most parastomal herniasare asymptomaticand do not often require surgical treatment. However, there are still some life-threatening complications, such as strangulation, perforation, and obstruction.Although several techniques have been reported to prevent parastomal hernia, the results are poor[18–20].So preventing a parastomal hernia is the best route. EPC is considered a solution to decrease the rate of parastomal hernia[21].Thelatest meta-analysis of 1048 patients showed a lower rate of parastomal hernia with EPC[22]. This is consistent with most of the evidenceprovided before[21, 23, 24].

Our studies also showed that theincidence of parastomal hernia was lowerusing theEPCcompared with the transperitoneal route. The possible reasons could be the lateralspacebetween the colon and the abdominal wall caused by the surgery. The sigmoid colonispulled out throughthe extraperitoneal space, which is an effective method of avoiding the space.Meanwhile, the transperitoneal route has additional coverage of the lateral peritoneal flap, to some extent, it may strengthen the abdominal wall while the force on the abdominal wall is more evenly spread with the lateral peritoneal flap[25]. Furthermore, the larger contact surface between the colon and peritoneum increases the direct friction so that it may not easily herniate[26].

Although, our analysis showed a good result in EPC. There are still some shortagesthat can't be ignored.Firstly, there is currently no consensus diagnosis criteria of parastomal hernias.Secondly, the published articles made no mention of the diagnosis criteria.Thirdly, all included articles are all small number, single-center trials.

Stoma prolapse

Stoma prolapse is a common late complication of stoma formation. The incidence rate is variable and depends on systematic and long-term follow-up.Its prevalence variesaccording to type and ranges from 2 to 22%[27, 28]. There is disagreement about the effect of an extraperitoneal stoma on stomal prolapse.Lian*et al.*[29]in comparing the meta-analysis with EPC and TPC,found no statistical difference in the rates of prolapsed (3.4% VS 5.7%)(OR = 0.61,P = 0.38).Kroese*et al.*[30]reported a decreased incidence of prolapsed in EPC in the latest meta-analysis, and the overall incidence of

stoma prolapsed was 2 of 185 (1.1%) after extraperitoneal construction compared with 13 of 179 (7.3%) afterTPC (RR = 0.21, P = 0.01). Our results showed a statistically lower rateof prolapse in EPC.Some surgeons suggest that intra-abdominal fixation of the stoma can prevent this complication.Goligher[31] hypothesized that EPC may reduce the incidence of prolapse, as the bowel may be better fixed by its oblique exit from the abdomen. The oblique tunnel of the bowel through the abdominal wallreduces the likelihood of prolapse by providing additional friction and adhesion.

Stoma retraction

The overall incidence of stomal retraction ranges from 1.4 to 9%. Retraction is often associated withadditional complications includingleakage, mucocutaneous separation, peristomal skin, and peristomal abscess, whichseverely influences the quality of life in patients[32, 33]. Our statistical analysis showed no significantdifference in stoma retraction (0.51% VS 3.70%, P = 0.08).The most common cause of retraction is excessive tensionon the stoma, which is usually the result of inadequate mobilization.This could be technically solved by adequate mobilization of sigmoid, descending colostomies, and even splenic flexure[31, 34, 35].

Stoma ischemia and necrosis

Ischemia and necrosis of a stoma is an early complication. It has been reported to occur in up to 20% of ostomates[36]. All the published data showed no difference between EPC and TPC[37].The major cause of ischemia and necrosis is impairment of blood supply which mainly resulted from excessive trimming of the epiploic fat and the mesentery[38].But the statistical analysis showed there was no significantdifference (2.24% VS 4.62%, P = 0.23). EPC may not increase the risk of blood supply disorder.

Sensation of Defecation

The sense of defecation is comparatively seen more in the extraperitoneal group(P 0.00001). Following the EPC, the contact area between the sigmoid colon and peritoneum gets established. The abundant nerve endings in the parietal peritoneum get stimulated by passes of feces. The peritoneal nerves arouse a sense of defecation. Promoting bowel control effectively and improves the quality of life. A new defecation reflex may be established when feces pass through the intestinal canal covered by the peritoneum.

Colostomy Construction Time

Colostomyconstruction time is a surgeon's skill-related heterogeneity. Wang *et al.*[39] analyzed 231 patients,and the results showed that the average time in the extraperitoneal group was 19 min and that inthe transperitoneal group was 27 min(P < 0. 001). WhileZhang *et al.*[40] found there was no statistical difference in both groups. The time of the extraperitoneal stoma was mainly spent in the creation of the extraperitoneal tunnel, but the time of suture and fixation was less. Our analysis showed a statistically equivalent result with high heterogeneity(I^2 = 100%). Compared with theTPC, the EPC did not significantly increase the time of the colostomy construction. But it still needs more studies to identify with standard surgical procedures.

The main limitation of our study is the small number, single-center trials. The high-quality, multicenter randomized controlled trials, with a large number of patients, are still awaited to do further analysis.

Conclusion

In conclusion, based on the evidence, permanent colostomy via an extraperitoneal route showed advantages when compared to transperitoneal colostomy.

Abbreviations

EPC: Extraperitoneal colostomy

TPC: Transperitoneal colostomy

OAPR: Open abdominoperineal resection

LAPR: Laparoscopic abdominoperineal resection

Declarations

Availability of Data and Materials

All data generated or analysed during this study are included in this published article.

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable

Competing interests

The authors declare that they have no competing interests.

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None

Authors' contributions

Jinlong Luo, Dujanand Singh, FaqiangZhang, Xinting Yang, Xiaoying Zha, and Huaiwu

Jiang contributed equally to this work.

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Figures

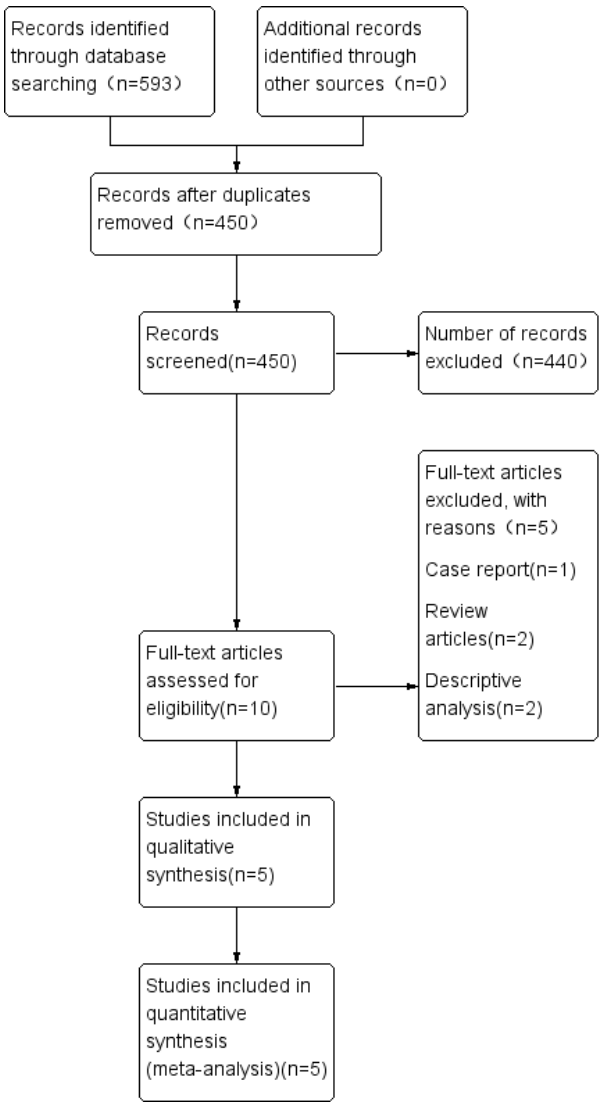

Figure 1

Flow diagram of studied identified, included and excluded

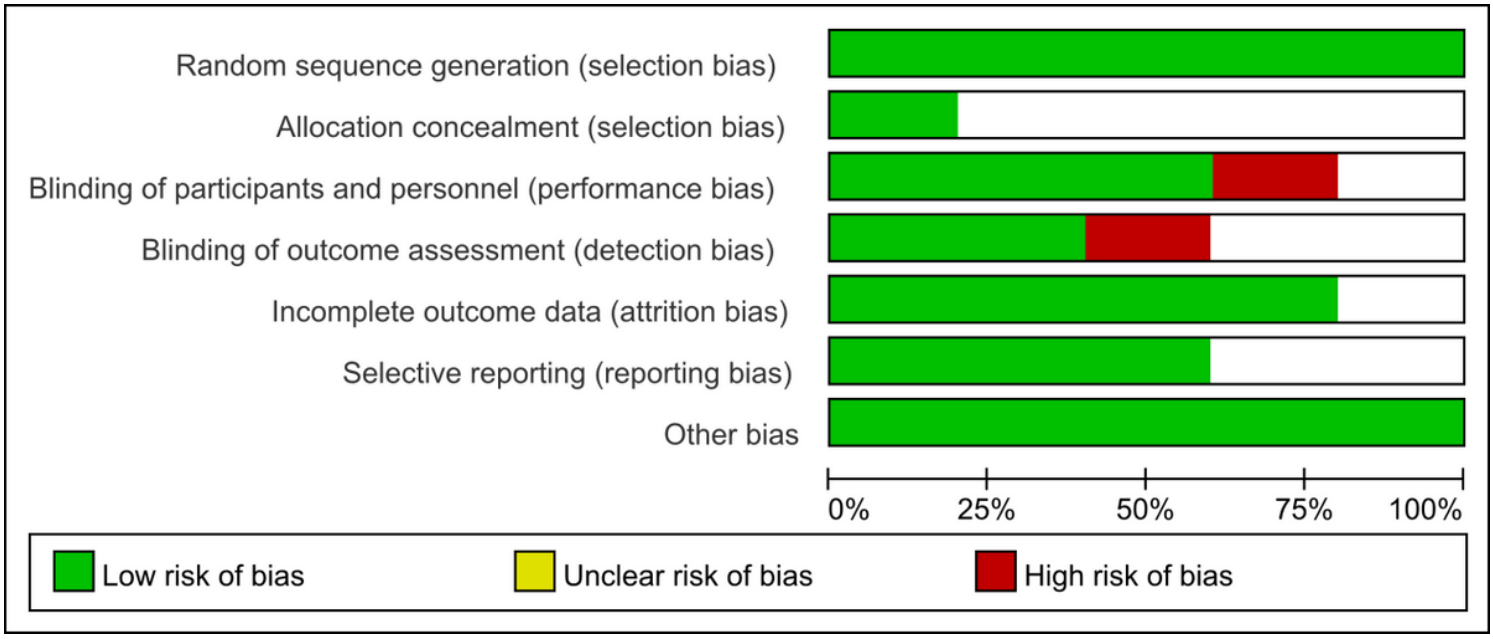

Figure 2

Summary of risk of bias assessment

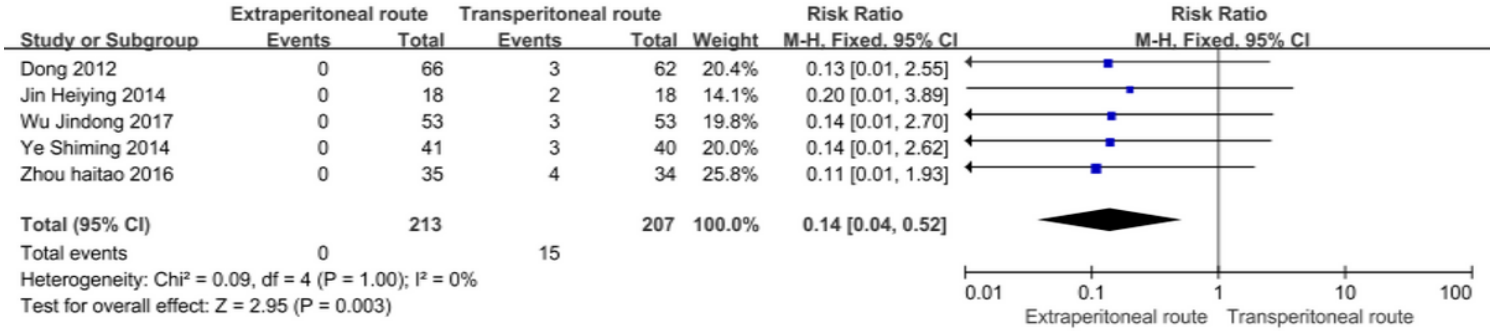

Figure 3

Forest plot of Parastomal Hernia.

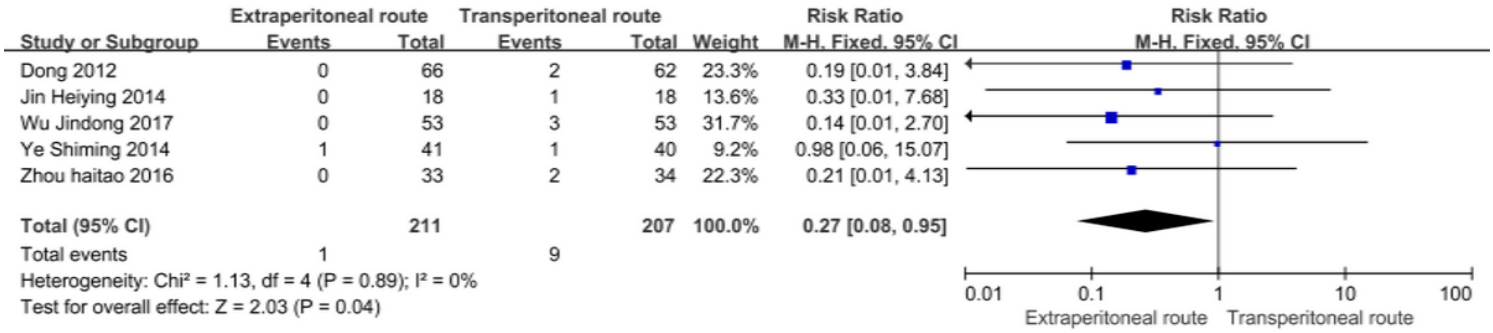

Figure 4

Forest plot of Stoma Prolapse.

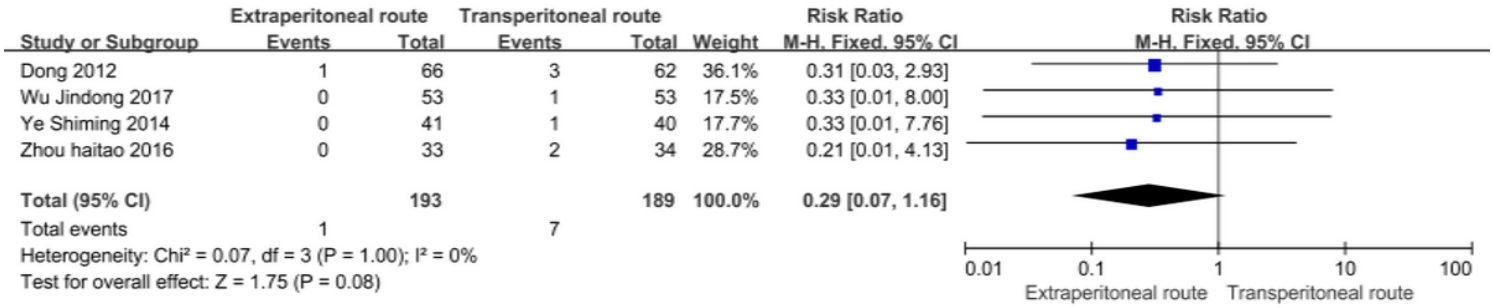

Figure 5

Forest plot of Stoma Retractions.

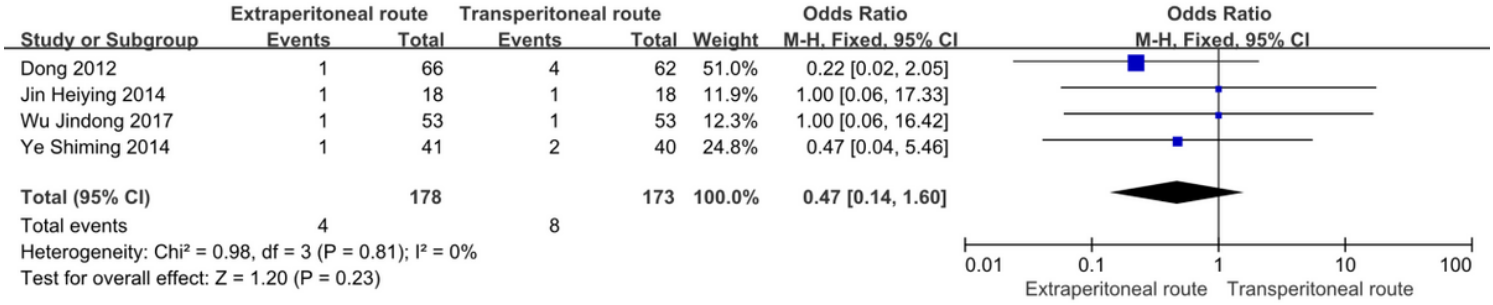

Figure 6

Forest plot of Stoma Ischemia and Necrosis.

Figure 7

Forest plot of Defaecation Sensation.

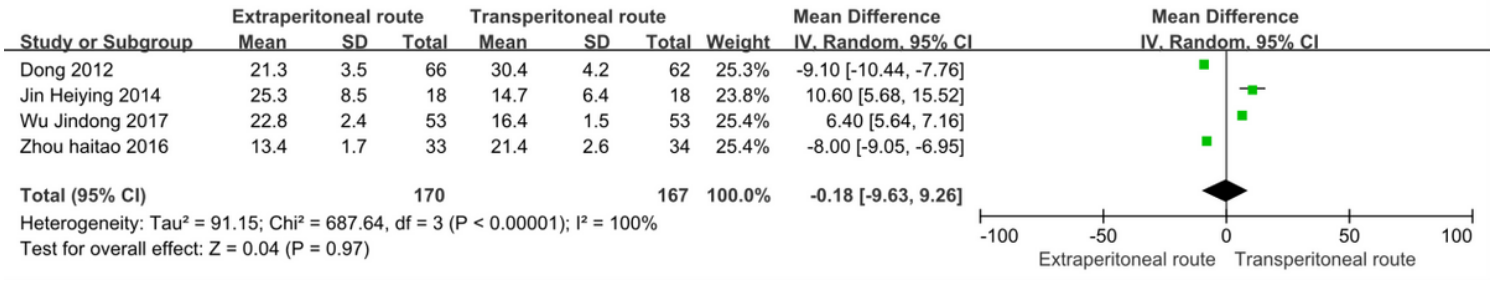

Figure 8

Forest plot of Colostomy Construction Time.