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Transumbilical versus periumbilical incision for laparoscopic surgery: A meta-analysis

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ABSTRACT

Background: Whether a transumbilical or periumbilical incision is beneficial for the initial peritoneal access in laparoscopic abdominal surgery has been debated. Our aim is to determine whether a transumbilical or periumbilical incision is a better route for the initial umbilical trocar.
Methods: PubMed, Embase, and Cochrane Library databases were searched for articles published before March 2020. The meta-analysis calculated the pooled effect size by using a random effects model.
Results: Five trials involving 783 patients were reviewed. The transumbilical group significantly reduced operation time (mean difference: −7.73; 95% confidence interval: −13.10 to −2.35) when compared to the periumbilical group. The length of hospital stay, mean pain scores on operation day and post-operation day 1 did not differ significantly between the two groups. Moreover, the incidence of surgical site infection, cosmetic satisfaction, and complication rate did not differ significantly between groups.
Conclusion: A transumbilical incision is better than a periumbilical incision for laparoscopic surgery as it saves operation time. Hence, we suggest transumbilical incisions for the initial peritoneal access in laparoscopic abdominal surgery.

Introduction

Laparoscopic abdominal surgery is widely used in various surgical fields, including upper gastrointestinal, lower gastrointestinal, hepatobiliary, genitourinary, and gynecological surgeries.[1–5] Compared with conventional open surgery, laparoscopic surgery may offer superior surgical outcomes for most abdominal surgical procedures in terms of postoperative pain, hospitalization stay, wound healing, cosmetic satisfaction, and quality of life during the postoperative period.[5,6] However, a crucial aspect of laparoscopic surgery is the initial peritoneal access.[7]

During laparoscopic surgery, surgeons initially need to create a route for inserting the laparoscope. Consequently, a transumbilical or periumbilical incision is required. In the transumbilical method, a vertical or transverse cut extending the full length of the umbilicus is usually made. Conversely, in the periumbilical method, a transverse or U-shaped cut beneath or above the umbilicus is made. According to statistics, a vast majority (>85%) of Canadian general surgeons prefer periumbilical incisions to transumbilical incisions during their laparoscopic interventions; however, Asian surgeons seem to use transumbilical incision as the standard procedure.[8] These two methods have their own advocates. As the layers of the abdominal wall converge at the umbilicus, transumbilical incisions may be relatively easy and fast in terms of laparoscope placement and incision closure.[7] Moreover, considering the cosmetic outcome, with transumbilicus incisions, the scar is not apparent and the wound gets hidden within the umbilicus. Conversely, the potential negative effect of transumbilical incisions is the increased rate of surgical site infection because the umbilicus is prone to microbacterial colonization.[9]

Lee et al. discovered that in laparoscopic cholecystectomy, transumbilical incisions were associated with a significantly higher

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score in terms of cosmetics than periumbilical incisions, but no significant difference was observed in analgesic consumption.[7] By contrast, Siribumrungwong et al. suggested that periumbilical incisions result in a low superficial surgical site infection rate.[10] Nevertheless, the optimal position between the trocar access point and the umbilicus is controversial and integrated studies are lacking. Therefore, we conducted a systematic literature review and meta-analysis of randomized controlled trials (RCTs) to determine whether transumbilical or periumbilical incisions are beneficial in laparoscopic surgery.

Materials and methods

Inclusion criteria

RCTs investigating the outcomes of patients with different umbilical incisions who had undergone laparoscopic surgery were included in this review. We selected RCTs clearly reporting the inclusion and exclusion criteria for patients, techniques used for laparoscopic surgery, and definition and evaluation of perioperative outcomes. We excluded RCTs that met at least one of the following criteria: (1) patients had undergone single-incision laparoscopic surgery and (2) patient cohorts were reported in duplicate.

Search strategy and study selection

Relevant RCTs published before March 2020 were selected from PubMed, Embase, and Cochrane Library databases. The following keywords were used: “transumbilical” OR “intraumbilical” OR “periumbilical” AND “laparoscopic”. The “related articles” option in the PubMed database was applied to broaden the search scope, and all abstracts, studies, and citations retrieved were reviewed. In addition, we identified additional studies by using the reference sections of the relevant papers and by corresponding with subject experts. No language restrictions were applied. Our systematic review was accepted by PROSPERO, an online international prospective register of systematic reviews that is curated by the National Institute for Health Research (CRD42019134198). The study does not require institutional review board approval due to no human subjects involved.

Data extraction

Baseline and outcome data were independently abstracted by two reviewers (BHC and KWT), and study designs, study population characteristics, inclusion and exclusion criteria, surgical techniques, complications, and postoperation parameters were extracted. The reviewers' individually recorded data were compared. The authors of the studies were contacted for any additional information.

Methodological quality appraisal

Two reviewers (BHC and KWT) independently assessed the methodological quality of each study by using the revised Cochrane Risk of Bias tool (RoB 2.0).[11] Trials were awarded an overall risk of bias grade of high, some, or low. This grade was calculated by assessing five domains: bias arising from the randomization process; bias owing to deviations from intended interventions; bias owing to missing outcome data; bias in the measurement of the outcome; and bias in the selection of the reported results.

Outcomes

The primary outcome was the operation time required. The secondary outcomes were length of hospital stay, pain score during postoperative time, incidence rate of surgical site infection, cosmetic satisfaction, and complications including umbilical hernia and hemorrhage.

Statistical analyses

Data were recorded and analyzed using Review Manager, Version 5.3 (Cochrane Collaboration, Oxford, England). The meta-analysis was performed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses.[12] Standard deviations were calculated using the median and interquartile range reported in the RCTs. Continuous variables were analyzed using the mean difference (MD) and standard MD (SMD). Dichotomous outcomes were analyzed using weighted risk ratios (RRs). The precisions of the effect sizes were reported as 95% confidence intervals (CIs). Pooled estimates of the MD, SMD, and RR were computed using the DerSimonian and Laird random effects model.[13] The Cochran Q test and I^2 statistics were calculated to evaluate the statistical heterogeneity and inconsistency of the treatment effects, respectively, across the RCTs. Statistical significance was set at $P < 0.10$ for the Cochran Q test. Statistical heterogeneity across the RCTs was assessed using the I^2 test, which quantifies the proportion of the total outcome variability across the RCTs.

Results

RCT characteristics

Fig. 1 presents the flowchart of the screening and selection of RCTs. The initial search yielded 2894 citations from three different databases. However, we excluded 969 studies because of duplications and 1925 studies that investigated irrelevant topics, such as the effect of intraumbilical oxytocin injection; 580 studies were on topics unrelated to this study; 78 studies were related to comparisons different from the outcomes of our study such as transumbilical versus lateral transabdominal removal of benign adnexal masses through laparoscopy; and 1 study was a retrospective review article comparing periumbilical and intraumbilical incisions in laparoscopic appendectomy. Hence, in total, five RCTs were eligible for meta-analysis in this study.[7,10,14–16]

The five RCTs were published between 2016 and 2019, involved sample sizes ranging from 50 to 396 with a total of 783 participants. In three RCTs, patients who underwent laparoscopic cholecystectomy were recruited.[7,10,14] Rafique et al. recruited only patients with acute appendicitis.[15] Senturk et al. recruited patients who underwent laparoscopic gynecologic surgery.[16] Siribumrungwong et al. evaluated transumbilical and infraumbilical incisions[10]; Senturk et al. divided the participants into three groups based on the techniques used, namely infraumbilical, supraumbilical, and transumbilical techniques; and the remaining three RCTs compared transumbilical and periumbilical incisions.[7,14,15] In these studies, transumbilical incisions were made through the full length of the umbilicus.[7,10,14–16] In two trials, the direction of the incision was determined based on the characteristics of the umbilicus, whereas in the other three trials, vertical incisions were made.[10,16] Conversely, Bouffard-Cloutier et al. made periumbilical incisions with a 10–15 mm curvilinear horizontal incision that did not pass through the umbilicus,[14] and in two RCTs, periumbilical incisions were made with a U-shaped incision beneath or above the umbilicus.[7,15] Moreover, for the supraumbilical and infraumbilical groups, Senturk et al. made transverse or vertical supraumbilical incisions and infraumbilical incisions, respectively.[16] Siribumrungwong et al. made a transverse incision at 1–2 cm below the umbilicus for the infraumbilical group.[10] Whether the umbilicus is involved is the key difference in our comparison. Therefore, we classified both patients with infraumbilical and

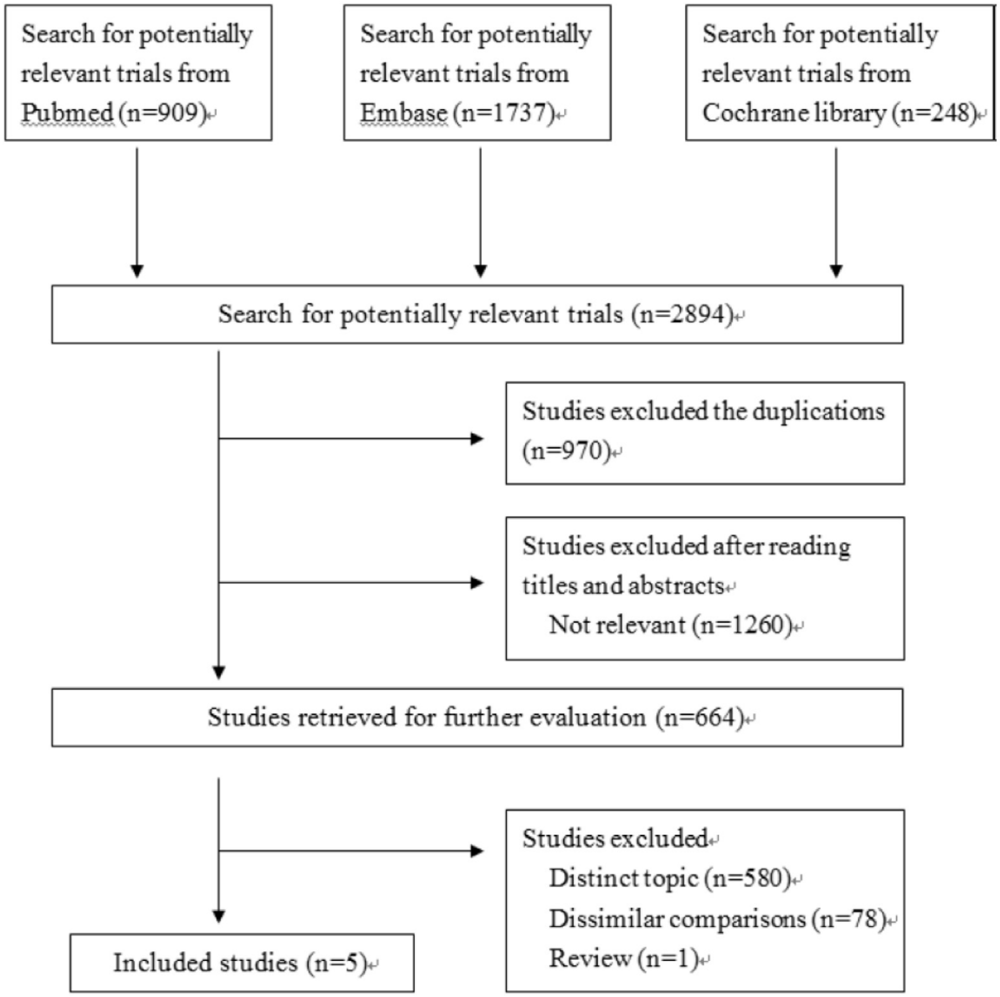

Fig. 1. Flowchart of RCT selection.

supraumbilical incisions as patients with periumbilical incisions. In addition, the other group included patients with only transumbilical incisions, also known as intraumbilical incisions. Four of our included RCTs recorded body mass index (BMI) data, and most of the patients were normal to mildly overweight. Mean of their BMI ranged from 24 to 29.[7,10,14,16] Across all the five RCTs, patient numbers in the two treatment groups were comparable (Table 1).

The methodological qualities of the included RCTs are summarized in Table 2. All RCTs had followed acceptable randomization methods.[7,10,14–16] One RCT had a baseline imbalance between the transumbilical and periumbilical groups in terms of patient age (42.25 ± 7.30 vs 23.53 ± 4.15).[15] Three RCTs stated that the surgeons were not blinded,[7,10,14] and two RCTs did not mention the blinding of surgeons.[15,16]

In most of the outcomes in our comparison, the blinding status of participants had little influence. Thus, only two RCTs described the blinding status of patients. Lee et al. stated that the patients were blinded to the allocated group, whereas Siribumrungwong et al. stated that patients could not be blinded because of the nature of the operative procedure.[7,10] Performance bias was a concern in one RCT because one patient discontinued the procedure and opted for laparotomy.[14] Four RCTs described the blinding of the outcome assessors,[7,10,15,16] and one study mentioned that the assessors were not blinded, which contributed to measurement bias.[14] One RCT reported a 9% loss to follow-up, but the loss was not due to poor responders and was not likely associated with the true outcome value in the transumbilical and periumbilical groups. Therefore, the attrition bias of this RCT was ranked as a low risk.[14] Finally, the reporting bias in all RCTs was considered a low risk because there were no multiple outcome measurements, multiple analyses of the data, and a change in the pre-specified plan of the trial analysis.[7,10,14–16]

Operation time

Three RCTs assessed operation time.[7,10,14] The transumbilical group required significantly less operation time compared with the periumbilical group (MD: −7.73 min; 95% CI: −13.10 to −2.35). The I^2 value was 0% in these groups, indicating the absence of heterogeneity across RCTs (Fig. 2).

Length of hospital stay

Two RCTs assessed the length of hospital stay.[7,10] The transumbilical group had a nonsignificantly shorter length of hospital stay than the periumbilical group (MD: −0.11 day; 95% CI: −0.40 to 0.17) (Fig. 3).

Table 1
Characteristics of included studies.

Author [Year]	Inclusion criteria	Number of patients (% male)	Age, year, mean ± SD	BMI, kg/m^{-2},mean ± SD	Intervention
Bouffard-Cloutier [2017]	18–70 years, patients received LC, laparoscopic rectopexy, appendectomy, or proctocolectomy	I: 23 (39.1)	I: 48.8 [34.9 –60.9][a]	I: 26.7 ± 3.0	I: a vertical incision through the full length of the umbilicus
		P: 27 (25.9)	P: 40.3 [28.9 –56.8][a]	P: 28.9 ± 5.3	P: a 10–15-mm curvilinear horizontal incision that is not through the umbilicus
Lee [2016]	Patients received LC for acute or chronic cholecystitis, gallbladder polyp, adenomyomatosis, or porcelain gallbladder	I: 64 (45.3)	I: 52.1 ± 14.5	I: 24.4 ± 3.4	I: a vertical incision inside the umbilicus
		P: 66 (54.5)	P: 55.7 ± 17.4	P: 24.7 ± 4.0	P: a U-shaped incision beneath or above the umbilicus
Rafique [2017]	>16 years, patients with acute appendicitis	I: 198 (64.1)	I: 42.25 ± 7.3	N/P	I: a vertical incision through the full length of the umbilicus
		P: 198 (64.1)	P: 23.53 ± 4.15		P: a U-shape incision beneath or above the umbilicus
Şentürk [2018]	Patients underwent laparoscopic gynecologic surgery	I: 34 (0)	I: 42.26 ± 11.61	I: 24.32 ± 4.91	I: a transverse or vertical transumbilical incision
		S: 36 (0)	S: 40.14 ± 12.17	S: 24.68 ± 4.76	S: a transverse or vertical supraumbilical incision
		IF: 35 (0)	IF: 37.03 ± 11.93	IF: 24.66 ± 3.4	IF: a transverse or vertical infraumbilical incision
Siribumrungwong [2015]	>18 years, patients underwent elective conventional LC	I: 51 (47)	I: 50 ± 13	I: 24.5 ± 3.9	I: a transverse or vertical incision through the full length of the umbilicus depending on the characteristics of the umbilicus
		IF: 51 (35)	IF: 53 ± 13	IF: 24.3 ± 3.5	IF: a transverse incision at 1–2 cm below the umbilicus

Abbreviations: I: intraumbilical (transumbilical) incision, P: periumbilical incision, S: supraumbilical incision, IF: infraumbilical incision, LC: laparoscopic cholecystectomy.
[a] Indicates an interquartile range.

Pain score during postoperative time

Two RCTs assessed postoperative pain using a 10-point visual analog scale.[7,10] Lee et al. assessed the pain score on operation day and postoperation days 1 and day 2, whereas Siribumrungwong et al. evaluated the pain score at 6 h, 24 h, and 7 days postoperatively. The differences in the mean pain scores on operation day (MD: −0.15; 95% CI: −0.63 to 0.34) and postoperation day 1 (MD: 0.02; 95% CI: −0.57 to 0.60) were not significant between the transumbilical and periumbilical groups (Fig. 4).

Moreover, Lee et al. observed that the pain scores did not differ significantly (MD: −0.20; 95% CI: −0.53 to 0.13) in the transumbilical and periumbilical groups 2 days postoperatively.[7] Siribumrungwong et al. observed that pain scores of the transumbilical group were not significantly higher than those of the periumbilical group (MD: 0.20; 95% CI: −0.14 to 0.54) at 1 week after surgery.[10]

Rate of surgical site infection

Four RCTs assessed the rate of surgical site infection.[7,10,14,15] Rafique et al. used a four-point collective scale and infection was confirmed if the score was 3 or more in 7 days. Siribumrungwong et al. diagnosed surgical site infection based on the Center for Disease Control criteria in 7–10 days.[10,17] Bouffard-Cloutier et al. assessed surgical site infection by reviewing the 4–6 week-post-op notes but did not clearly define the criteria.[14] However, Lee et al. did not mention the criteria and follow-up time.[7] The pooled results showed nonsignificant differences in the incidence of surgical site infection, with an RR of 1.10 (95% CI: 0.25–4.85). The I^2 value was 54%, which indicated moderate heterogeneity (Fig. 5).

Cosmetic satisfaction

Four RCTs assessed the cosmetic satisfaction of patients by using different assessment tools at different time points from 1 week to 6 months postoperatively.[7,10,14,16] Two RCTs used a 10-point scale for evaluation.[10,14] The other two RCTs conducted by Lee et al. and Senturk et al. were not included in data pooling because they used 44- and 13-point scales with different subdomains, respectively.[7,16] Bouffard-Cloutier et al. showed that the MD of satisfaction scores was 0.00 (95% CI: −0.88 to 0.88) at 6 months, and Siribumrungwong et al. found that the MD was −0.10 (95% CI: −0.55 to 0.35) at 3 months postoperatively.[10,14] The total pooled data did not show a significant difference between the transumbilical and periumbilcal

Table 2
Methodological quality assessment of included trials.

Study(year)	Bouffard-Cloutier (2017)	Lee (2016)	Rafique (2017)	Şentürk (2018)	Siribumrungwong (2019)
Bias arising from the randomization process	Low risk	Low risk	Some concerns[a]	Low risk	Low risk
Bias due to deviations from intended interventions	Some concerns[b]	Low risk	Low risk	Low risk	Low risk
Bias due to missing outcome data	Low risk	Low risk	Low risk	Low risk	Low risk
Bias in measurement of the outcome	Some concerns[c]	Low risk	Low risk	Low risk	Low risk
Bias in selection of the reported result	Low risk	Low risk	Low risk	Low risk	Low risk
Overall risk of bias	Some concerns[d]	Low risk	Some concerns[e]	Low risk	Low risk

Methodological quality assessment was based on the Cochrane risk of bias tool (RoB 2.0).
[a] The randomized baseline imbalances between two groups probably suggest a problem.
[b] No blinding was performed in both groups and one failure in implementation would affect the outcome although the analysis was probably appropriated.
[c] Outcome assessors were aware of the intervention received but were unlikely to be influenced by the knowledge of intervention.
[d] The study raises some concerns in two domains for this result, but it is not at a high risk of bias for any domain.
[e] The study raises some concerns in one domain for this result, but it is not at a high risk of bias for any domain.

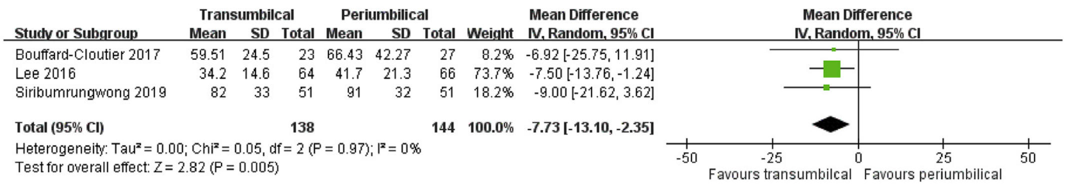

Fig. 2. Forest plot of comparison: Operation time; outcome: the transumbilical group had significantly reduced operation times compared with the periumbilical group.

groups (MD: −0.08; 95% CI: −0.48 to 0.32) (Fig. 6).

Lee et al. evaluated cosmetic satisfaction using a body image questionnaire 1 week after discharge, with scores ranging from 0 to 44 and a high score corresponding to a high body image. The cosmetic survey score was significantly higher in the transumbilical group than in the periumbilical group (36.8 ± 5.2 vs 33.2 ± 5.2, P < 0.001).[7] Senturk et al. used a Vancouver scar scale that evaluated vascularity, pigmentation, pliability, and height. In this scale, a high score indicates poor scaring. This RCT found that cosmetic results did not differ statistically between the transumbilical, infraumbilical, and supraumbilical groups (4.88 ± 1.45 vs 4.83 ± 1.54 vs 5.11 ± 1.75, P = 0.631) 3 months after surgery.[16]

Complications

In two RCTs, the incidence rates of postoperative complications were compared.[7,10] Lee et al. found no difference between the transumbilical and periumbilical groups in the rates of complications (4.7% vs 7.6%, P = 0.496), including those for wound infection, hemorrhage, paralytic ileus, and postoperative nausea and vomiting at 2 weeks postoperatively.[7] Siribumrungwong et al. found similar rates of complications, including those for wound numbness (0% vs 2%, P = 1), wound hypersensitivity (10% vs 16%, P = 0.379), and superficial surgical site infection (16% vs 4%, P = 0.07) at 3 months after surgery.[10] Lee et al. and Siribumrungwong et al. both stated that there were no umbilical hernias during the follow-up time in the transumbilical and periumbilical groups.[7,10]

Discussion

Our meta-analysis indicated that transumbilical incisions significantly decreased the operation time compared with periumbilical incisions. However, in terms of the length of hospital stay; pain within 7 days postoperatively; incidence of surgical site infection; and cosmetic satisfaction at 1 week, 1 month, and 3 and 6 months postoperatively, the results for transumbilical and periumbilical incisions were the same for laparoscopic surgery. Therefore, performing transumbilical incisions has modest benefits for laparoscopic surgery.

The umbilicus is situated slightly deeper than its surrounding areas, leading to increased chances of bacterial infection compared with its surrounding.[15] Therefore, avoiding umbilical incision was considered beneficial in reducing surgical site infection. However, Hamzaoglu et al. concluded that umbilical flora is not responsible for trocar site infections.[18] Furthermore, Kleeff et al. believed that the vast majority of surgical site infections were caused by intra-abdominal contamination rather than the skin microflora.[19] Our meta-analysis showed nonsignificantly higher rates of surgical-site infection with umbilical penetration than with periumbilical incision. Furthermore, Hamzaoglu et al. suggested that hospital-acquired and intra-abdominal pathogens are responsible for trocar site infections, and preoperative povidone-iodine is believed to be an effective antiseptic agent.[18] Thus, umbilical incision does not appear to be related to the increase in trocar site infection.

Moreover, operative time required is a crucial aspect for both surgeons and patients. The operation time may be affected by various factors, including the skill and proficiency of the surgical team, surgical instruments used, and certainly the maneuver used in the operation. Trocar penetration may be easier with transumbilical incisions because the periumbilical tissue is thicker than the umbilical tissue. In our included trials, three RCTs involved laparoscopic cholecystectomy and assessed the operation time. Bouffard-Cloutier et al. revealed a trend of shorter operation time in transumbilical incisions than in periumbilcal incisions.[14] Lee et al. stated that the average operation times for the transumbilical and periumbilical groups were 34.2 and 41.7 min, respectively.[7] Similarly, Siribumrungwong et al. showed a mean operation time of 82 min for the transumbilical group and 91 min for the periumbilical group.[10] According to our analysis, transumbilical incisions are more timesaving than periumbilical incisions for accessing the peritoneum with a trocar in laparoscopic surgery. Lee et al. acknowledged that separate measurements of wound opening or closing time were not measured in their study.[7] The time consumption of the incisional fascial dilation for organ extraction may also be the decisive part in laparoscopic surgery, especially cholecystectomy. Therefore, more studies with multiple types of surgeries are required to confirm the difference of operation time between groups.

The size of the incision for trocar port access may affect the outcomes of the transumbilical and periumbilical methods. Generally, a 10-mm endoscope is used in conventional laparoscopic cholecystectomy.[20] If the umbilical incisional wound is large, it may lead to an increased rate of hernia, increased pain, and poor cosmetic result. In this context, Bender et al. demonstrated that laparoscopic cholecystectomy using all 5-mm ports is both feasible and safe and is comparable with published outcomes after conventional laparoscopic cholecystectomy.[21] In our included trials, four RCTs chose 10-mm ports for the umbilical incision in both groups,[7,10,14,16] and Rafique et al. did not report the port size used.[15] As most of the outcomes from our included RCTs were based on 10-mm ports,

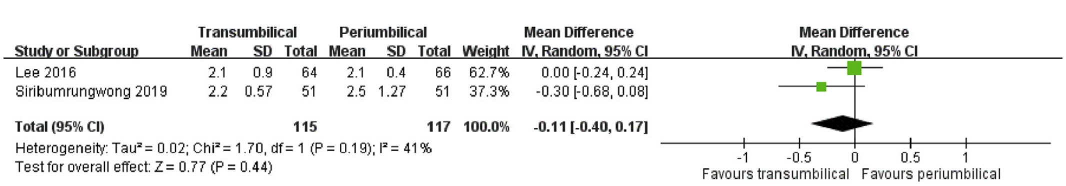

Fig. 3. Forest plot of comparison: Length of hospital stay; outcome: no significant difference was observed between the transumbilical and periumbilical groups.

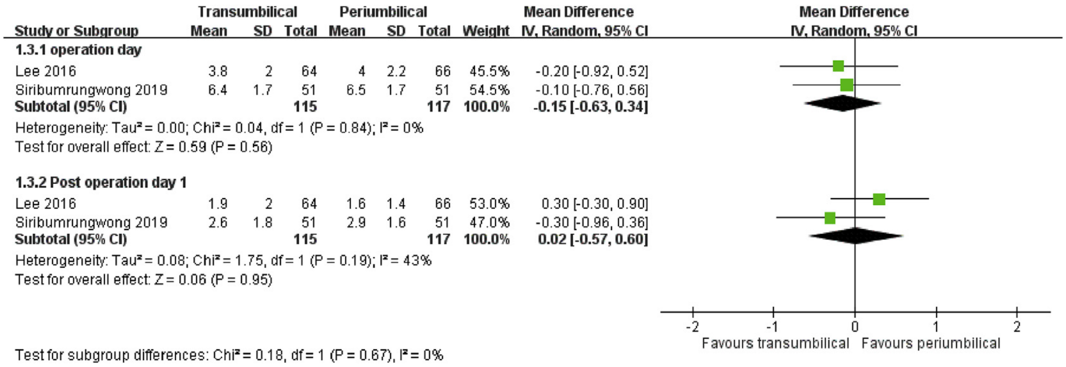

Fig. 4. Forest plot of comparison: Pain scores on operation day and postoperation days 1; outcome: no significant difference was observed between the transumbilical and periumbilical groups.

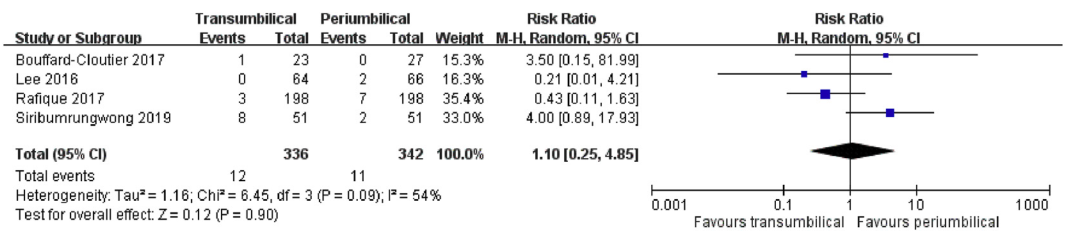

Fig. 5. Forest plot of comparison: Surgical site infection rate; outcome: no significant difference was observed between the transumbilical and periumbilical groups.

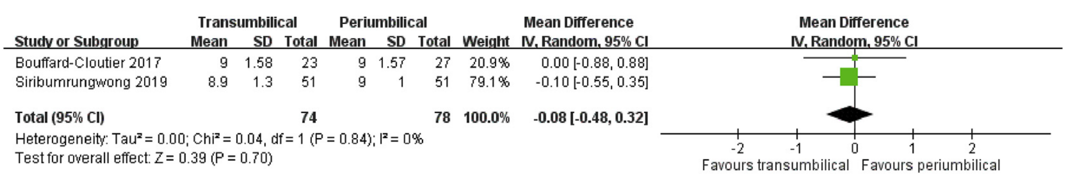

Fig. 6. Forest plot of comparison: Cosmetic satisfaction at 3–6 months; outcome: no significant difference was observed between the transumbilical and periumbilical groups.

additional research is necessary to determine the relationship between transumbilical and periumbilical incisions in different incisional wound sizes for laparoscopic abdominal surgery.

Different surgeries may lead to diverse outcomes. The RCTs that we reviewed investigated several laparoscopic surgeries. Three of our included RCTs evaluated the outcomes of laparoscopic cholecystectomy.[7,10,14] Lee et al. and Siribumrungwong et al. recruited only patients with cholecystectomy, whereas Bouffard-Cloutier et al. included rectopexy, appendectomy, and proctocolectomy. Moreover, Rafique et al. and Senturk et al. surveyed the outcomes of patients who received gynecologic surgery and appendectomy, respectively.[15,16] Although the operations differed, the heterogeneity in most outcomes were relatively low.

Considerable heterogeneity was observed across the RCTs included in our analysis because of various clinical factors. First, the surgeons acquired different surgical experiences in our included RCTs. None of the trials reported the effects of surgeons' expertise, which might have contributed to the differences in treatment outcomes. Second, the direction of incision in the periumbilical groups varied. In two RCTs, the skin was cut in a U-shape,[7,15] whereas in the others, a cut was made in curvilinear horizontal, transverse, and vertical directions.[10,14,16] Third, the surgical types differed across the RCTs. Four RCTs involved cholecystectomy, appendectomy, and proctocolectomy, whereas one RCT involved gynecologic surgery. In addition, Senturk et al. collected data only from women who underwent gynecologic surgery. Pain tolerance and cosmetic concern probably varied according to the sexes. Finally, some outcomes, such as pain scores, were measured at different time points.[7,10] Such differences among the RCTs resulted in heterogeneity.

This study had several limitations. First, several factors may have led to bias in the evaluation of outcomes, including inadequate information regarding randomization sequence, lack of blinding of the assessing personnel, and the use of per-protocol principle. Second, the RCTs did not include patients aged less than 16 years, and most of the participants' BMI ranged from 24 to 29. Consequently, we keep a conservative attitude toward our result when applying to pediatric or obese populations. Since obesity is likely to have a negative impact on the outcomes of laparoscopic surgery, more studies associated with the obese are indispensable. Third, the follow-up time was probably not sufficient for evaluating cosmetic satisfaction and hernia incidence.

Conclusion

Our study concluded that transumbilical incisions significantly decreased the operation time compared with periumbilical incisions. Moreover, transumbilical and periumbilical incisions in laparoscopic surgery were similar in terms of length of hospital stay, pain within 7 days postoperatively, incidence of surgical site infection, and cosmetic satisfaction postoperatively. Thus, we recommend transumbilical incisions for the initial peritoneal access when performing laparoscopic abdominal surgery. However, the available evidence is of variable quality, and additional well-structured RCTs with increased consistency in surgical types and cosmetic measurement, and adequately long follow-up duration are warranted.

Author contributions

Study concept and design: BHC and KWT.
Analysis and interpretation: SLS, BHC, and KWT.
Data collection: BHC and KWT.
Writing the article: BHC and KWT.
Critical revision of the article: SLS, BHC, and KWT.
Final approval of the article: SLS, BHC, and KWT.
Statistical analysis: BHC and KWT.
Overall responsibility: BHC and KWT.

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Declaration of competing interest

Dr. Ka-Wai Tam has received research grants from Yuan's General Hospital and Taipei Medical University. Drs. Shen-Liang Shih and Bo-Han Chen have no conflicts of interest or financial ties to disclose.

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