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ORIGINAL ARTICLE

Circular (purse-string) vs primary skin closure following stoma closure: an up-to-date systematic review and meta-analysis

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Abstract

Background Surgical site infections (SSI) are the most common complication after stoma closure. Circular skin closure (CSC) has been proposed to reduce SSI with comparable or even better outcomes than conventional primary sutures (PS). The aim of this meta-analysis is to compare circular with primary skin closure in stoma closure.

Method A systematic review of the literature was performed for articles published between January 2010 and June 2023, including all randomized control trials (RCT) on wound infection of adult patients following stoma reversal. The primary outcome was 30-day SSI; secondary outcomes were operative time, length of stay, and incisional hernia.

Results Eight RCTs were identified that included a total of 606 patients undergoing stoma closure surgery. Four percent of patients in the CSC group developed SSI, compared to 27% of patients undergoing PS. The 30-day SSI rate was lower after the circular skin closure (OR 0.11, 95% CI 0.06–0.21; $p < 0.00001$, $I^2 = 0\%$). There was no difference in the operative time (99.2 vs 103.5 min; MD −0.17, 95% CI −0.37, 0.03; $p = 0.10$), length of stay (7.1 vs 7.7 days; MD −0.34, 95% CI −0.55, −0.12; $p = 0.002$), and incisional hernia rate (2% vs 4%; OR 0.61, 95% CI 0.23, 1.60; $p = 0.31$).

Conclusion CSC is associated with lower SSI rate and should be preferred to linear skin closure technique after stoma closure surgery.

Keywords Surgical wound infection · Postoperative complications · Ostomy closure · Skin closure

Introduction

Stoma closure is an a common operation performed worldwide owing to the increasing number of operations resulting in a stoma being constructed: in the USA, approximately 100,000 patients each year undergo stoma creation [1]. Surgical site infections (SSI) represent the most common complication after stoma closure, with rates ranging from 0 to 41% [2], although small bowel obstruction, anastomotic leak, and incisional hernia may also occur. SSI negatively affect the quality of life of patients [3] and increase the costs for the health service [4].

To improve the postoperative results and reduce the SSI rate, in 1997 Banerjee [5] proposed a purse-string closure, consisting of a circular closure of the skin and subcutaneous tissue, leaving a little hole in the middle of the wound to allow secretion flow outside and thus preventing its accumulation in the subcutaneous tissue. An increasing number of studies support the advantages of this technique, also known as circular skin closure (CSC), in comparison with

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conventional primary sutures (PS) in terms of postoperative SSI, operative time, and incisional hernia, but the latter approach is still being used by several surgeons as the method of choice.

This systematic review and meta-analysis aims to compare CSC vs PS after stoma closure in terms of postoperative outcomes.

Materials and methods

The systematic review with meta-analysis was performed in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) Statement [6] and was recorded on the International Prospective Register of Systematic Reviews—PROSPERO (ID CRD42022375591).

Search strategy and data sources

A literature search of MEDLINE (PubMed), Embase, and Cochrane Central Register of Controlled Trials database was performed using for research the word string "[stoma closure OR stoma reversal] AND [wound infection OR ssi]". The reviewers independently analyzed initially only the title and abstract of the articles and, subsequently, the full text of the remaining selection. After further screening to assess the eligibility of the selection made, data were extrapolated. Only studies published after 2010 were evaluated. The following data were independently extracted from the included studies by the reviewers: first author, year, journal, country, study design, follow-up, type of operation, and the number of patients (total number, patients with CSC, and patients with PS). The last search date was June 1, 2023.

Data extraction

Data were collected in an Excel spreadsheet independently of the reviewers (FMT and GF); in case of conflict a third reviewer (FP) resolved disagreement. Data on gender, age, body mass index (BMI), diabetes, cardiovascular disease, pulmonary disease, smoking status, and American Society of Anesthesiologists (ASA) score were extracted.

Inclusion and exclusion criteria

Studies comparing patients with CSC and PS after stomal reversal were included, with only language publication restrictions. Patients of any age, gender, and type of stomas (loop ileostomy, end ileostomy, loop colostomy, end colostomy) were considered. Only randomized control trials (RCTs) that included data on the primary outcome were included. Retrospective studies, case reports, meta-analyses, and prospective non-randomized studies were not included in the analysis.

Two authors (FMT and GF) assessed the methodological quality and risk of bias of the included articles using the Cochrane RoB2 tool [7] for assessing the risk of bias in RCTs.

Endpoints and outcome measures

The primary endpoints included the risk of SSI, defined as infection of the wound occurring within 30 days after the operation. Secondary endpoints included operation time and length of stay (LOS) associated with the different treatments.

Statistical analysis

The meta-analysis was conducted in accordance with the MOOSE guidelines [8]. The estimated effect measures are reported as odds ratios (OR) with 95% confidence intervals (95% CI). The ratio represented the probability of occurrence of an event in the CSC group compared with the PS group. OR > 1 indicated worse outcomes for the CSC group, and the point estimate of OR was considered statistically significant if the 95% CI did not contain a value of 1. OR were combined with the Mantel–Haenszel chi-squared method by using the fixed effect technique [9]. To increase the quality of this meta-analysis, a fixed effect model was used because of the evidence of 0% heterogeneity However, the same value was found by performing an analysis with a random effect model.

For continuous parameters, the mean difference (MD) between the two groups was computed.

Data were analyzed using RevMan 5.4; in the studies with zero events, the RevMan software modifies 0 by applying a correction value of 0.5. The relative extent of observed heterogeneity was quantified using the I^2 statistic, ranging from 0% to 100% [10].

Results

A search of the literature yielded 9535 records; after screening examination, eight reports were eligible for the current meta-analysis [11–18]. The selection process is shown in Fig. 1.

Studies were published between 2010 and 2022; each study included patients with purse-string closure and linear sutures after stoma reversal. Data from the included studies are summarized in Table 1. All studies reported the operative time and LOS.

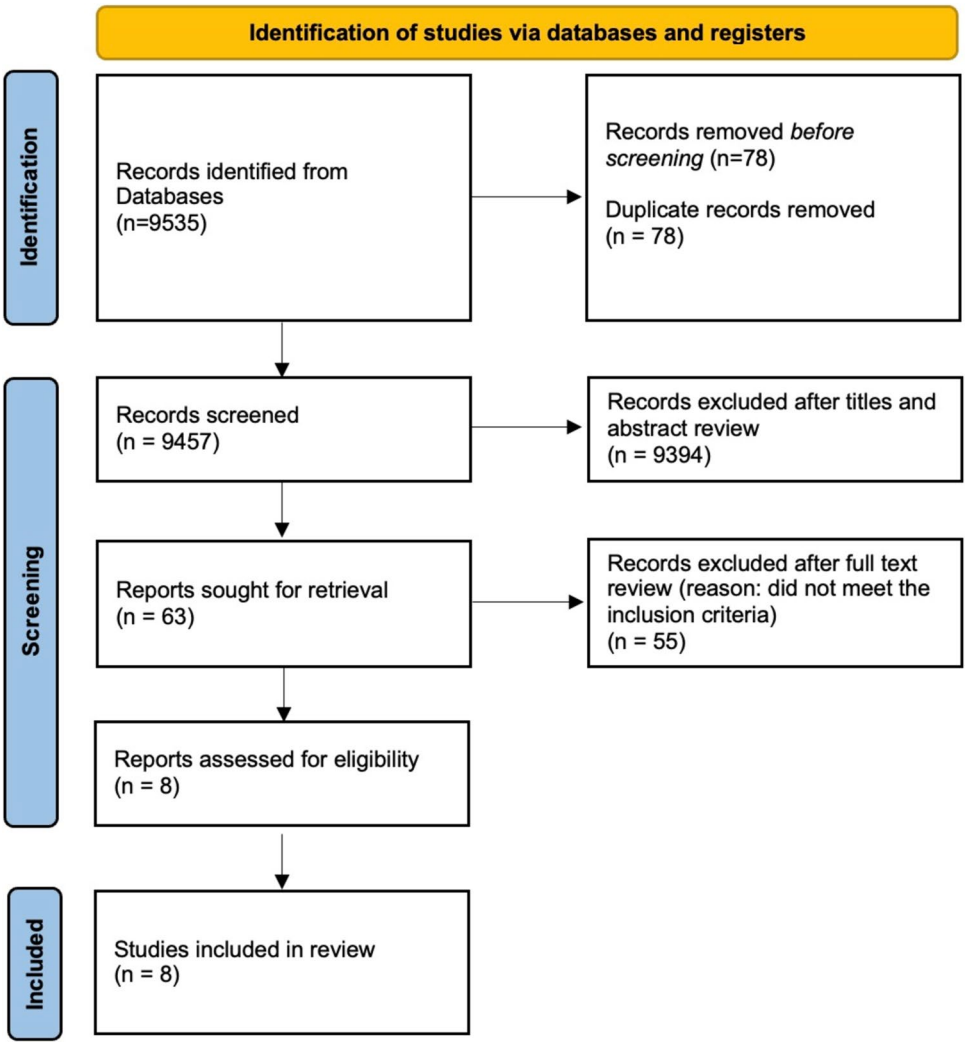

Fig. 1 Flowchart of study selection according to PRISMA statement

Characteristics of study population

The characteristics of the study population are summarized in Table 2.

Of the selected studies, 606 patients were included in the analysis: 310 patients (51%) belonged to the CSC group vs 296 patients (49%) to the PS group. Out of the 606 patients, 485 underwent ileostomy closure, and 121 patients underwent colostomy closure. Specifically, five studies analyzed patients undergoing ileostomy closure (344 patients) and three studies included both patients undergoing ileostomy closure (141 patients) and colostomy closure (121 patients) (Fig. 1).

In the two groups (CSC vs PS), the mean age of the patients was 50.6 vs 52.9 years (MD −0.13, 95% CI −0.30, 0.04; $p=0.13$), male gender rate was 60% vs 69% (OR 0.69, 95% CI 0.50, 0.97; $p=0.03$), and BMI was 24.5 vs 24.7 kg/m^2 (MD −0.07, 95% CI −0.27, 0.12; $p=0.47$).

Other baseline comorbidities including diabetes (22% vs 18%; OR 1.17, 95% CI 0.61, 2.23; $p=0.64$), cardiovascular disease (68% vs 49%; OR 1.57, 95% CI 0.97, 2.54; $p=0.07$), and pulmonary disease (6% vs 2%; OR 1.97, 95% CI 0.54, 7.21; $p=0.30$) and active smoking (22% vs 34%; OR 0.56, 95% CI 0.31, 1.01; $p=0.05$) were also analyzed.

ASA was reported in three studies: ASA 1 (66/249 vs 29/236; OR 1.61, 95% CI 0.83, 3.10; $p=0.16$), ASA 2 (6/249 vs 57/236; OR 0.71, 95% CI 0.38, 1.33; $p=0.28$), and ASA 3 (36/249 vs 8/236; OR 0.73, 95% CI 0.23, 2.32; $p=0.59$) patients.

Primary outcome

SSI occurred in 12/310 patients belonging to CSC group compared to 79/296 patients in the PS group (4% vs 27%, OR 0.11, 95% CI 0.06, 0.21; $p<0.0001$), with low heterogeneity ($I^2=0\%$, $p=0.88$). Results are shown in Fig. 2.

In the subgroup of patients that underwent ileostomy closure, SSI occurred in 6/141 patients belonging to the CSC group compared to 37/131 patients in the PS group (4% vs 28%, OR 0.12, 95% CI 0.065, 0.28; $p<0.0001$), with

Table 1 Characteristics of the studies

First author	Year	Journal	Country	Design	Follow-up (months)	Procedure	N. pts	CSC	PS	CSC suture thread	PS suture thread
Reid	2010	BJS	Australia	RCT	1	Ileostomy reversal	61	30	31	Prolene® 1–0	Caprosyn® 3–0
Camacho-Mauries	2013	Dis Colon Rectum	Mexico	RCT	12	Stoma reversal	61	31	30	Polypropylene® 0	Polypropylene® 2–0
Dusch	2013	Colorectal Dis	Germany	RCT	6	Ileostomy reversal	84	43	41	Prolene® 2–0	Seralon® 3–0
Lopez	2015	Tech Coloproctol	Philippines	RCT	1	Stoma reversal	121	61	60	Absorbable monofilament suture	Non-absorbable sutures
Alvandipour	2016	Ann Coloproctol	Iran	RCT	3	Ileostomy reversal	66	34	32	Vycryl® 2	Nylon® 3–0
O'Leary	2016	Tech Coloproctol	Ireland	RCT	6	Ileostomy reversal	61	34	27	Vycryl® 2–0 & Mocryl® 3–0	Vycryl® 2–0 & Mocryl® 3–0
Sureshkumar	2018	Cureus	India	RCT	3	Stoma reversal	80	40	40	Absorbable suture	Non-absorbable suture
Ali	2021	J Pak Med Assoc	Pakistan	RCT	3	Stoma reversal	72	37	35	Vycryl® 2–0	Prolene® 2–0

N. pts number of patients, *RCT* randomized control trial, *CSC* circular skin closure, *PS* primary suture, *CSC suture thread* suture thread used in circular skin closure group, *PS suture thread* suture thread used in primary suture group

low heterogeneity ($I^2 = 0\%$, $p = 0.67$). Results are shown in Fig. 2b.

Secondary outcomes

From seven studies, the average operating time and the average LOS were extracted: in the two groups (CSC vs PS) operative time was 99.2 vs 103.5 min (MD −0.17, 95% CI −0.37, 0.03; $p = 0.10$) and LOS was 7.1 vs 7.7 days (MD −0.34, 95% CI −0.55, −0.12; $p = 0.002$), with heterogeneity among the studies ($I^2 = 69\%$, $p = 0.007$ and $I^2 = 84\%$, $p < 0.0001$, respectively. Results are shown in Figs. 3 and 4.

The risk of developing incisional hernia was computed from five studies: 2% vs 4% (OR 0.61, 95% CI 0.23, 1.60; $p = 0.31$) with low-moderate heterogeneity ($I^2 = 34\%$, $p = 0.19$). Results are shown in Fig. 5.

Level of evidence and risk of bias

The overall strength of the evidence is summarized in Fig. 6. The certainty of the evidence found was high for all outcomes. All studies showed some concern about the risk of bias in the randomization process while a low risk was highlighted in every other RoB2 tool.

Discussion

The current meta-analysis provided the highest-quality evidence to demonstrate that CSC is superior to PS in terms of SSI risk. These results appear consistent, considering the high-quality of RCTs [11–18] included and the low statistical heterogeneity. No other advantages were detected regarding operative time, length of stay, and incisional hernia rate. However, considering the high healthcare and social cost associated with SSI, the advantage of CSC is apparent.

The studies analyzed have clinical heterogeneity explained by the fact that the different studies were conducted in different years and in different geographical areas. This aspect is significant for the purpose of the meta-analysis because it emphasizes that the double purse-string technique is not influenced by different local factors such as genetic factors, living conditions, climate, healthcare system, and different distribution of pathogens.

The mechanism behind this reduction in SSI rate is likely multifactorial: the hypodermic and dermal purse-string, made from absorbable thread, creates a small central orifice allowing the draining on any collection or secretion to occur at the level of the wound. To facilitate this task, a small gauze is inserted into this orifice and removed on the first postoperative day. Furthermore, the faster skin healing in comparison with the underlying layers may facilitate the collection of serum and/or

Table 2 Characteristics of the study population

First author	Ileostomy (% tot)	Colostomy (% tot)	CSC male (% tot)	CSC female (% tot)	CSC total (% tot)	PS male (% tot)	PS female (% tot)	PS total (% tot)	CSC age (SD)	PS age (SD)	CSC BMI (SD)	PS BMI (SD)	CSC diabetes (% tot)	PS diabetes (% tot)
Reid et al.	61 (10%)	0 (0%)	18 (3%)	12 (2%)	30 (5%)	27 (4%)	4 (1%)	31 (5%)	57.1 (17.8)	62.3 (11.0)	24.9 (5.0)	26.3 (4.9)	– (NA)	– (NA)
Camacho-Mauries et al.	40 (7%)	21 (3%)	21 (3%)	10 (2%)	31 (5%)	18 (3%)	10 (2%)	28 (5%)	48.3 (16)	49.3 (16.25)	24.8 (5.75)	23.4 (4.85)	0 (0%)	1 (0%)
Dusch et al.	84 (14%)	0 (0%)	27 (4%)	16 (3%)	43 (7%)	28 (%)	13 (2%)	41 (7%)	57.6 (15.75)	62.2 (14.06)	24.3 (4.73)	25.1 (4.09)	4 (1%)	2 (0%)
Lopez et al.	69 (11%)	52 (9%)	36 (6%)	25 (4%)	61 (10%)	43 (7%)	17 (3%)	60 (10%)	47.0 (13)	46.0 (14.5)	– (NA)	– (NA)	4 (1%)	1 (0%)
Alvandipour et al.	66 (11%)	0 (0%)	19 (3%)	15 (2%)	34 (6%)	16 (3%)	16 (3%)	32 (5%)	52.9 (13.95)	53.3 (13.66)	24.3 (2.34)	24.4 (2.56)	1 (0%)	2 (0%)
O'Leary et al.	61 (10%)	0 (0%)	19 (3%)	15 (2%)	34 (6%)	17 (3%)	10 (2%)	27 (4%)	60.7 (13.4)	59.3 (13.5)	25.8 (4.7)	26.3 (4.6)	3 (0%)	2 (0%)
Sureshkumar et al.	32 (5%)	48 (8%)	20 (3%)	20 (3%)	40 (7%)	28 (5%)	12 (2%)	40 (7%)	43.4 (16)	50.1 (16.25)	23.7 (3)	23.9 (4.85)	5 (1%)	6 (1%)
Ali et al.	72 (12%)	0 (0%)	25 (4%)	12 (2%)	37 (6%)	25 (4%)	10 (2%)	35 (6%)	41.3 (NA)	45.9 (NA)	23.8 (NA)	23.8 (NA)	5 (1%)	4 (1%)

First author	CSC CVD (% tot)	PS CVD (% tot)	CSC pulmonary (% tot)	PS pulmonary (% tot)	CSC smoke (% tot)	PS smoke (% tot)	CSC ASA 1 (% tot)	CSC ASA 2 (% tot)	CSC ASA 3 (% tot)	PS ASA 1 (% tot)	PS ASA 2 (% tot)	PS ASA 3 (% tot)	CSC time (SD)	PS time (SD)	CSC LOS (SD)	PS LOS (SD)
Reid et al.	– (NA)	– (NA)	– (NA)	– (NA)	– (NA)	– (NA)	9 (1%)	16 (3%)	5 (1%)	7 (1%)	17 (3%)	7 (1%)	48.4 (19)	48.2 (22)	5.5 (3.9)	6.1 (3.5)
Camacho-Mauries et al.	2 (0%)	3 (0%)	0 (0%)	1 (0%)	1 (0%)	1 (0%)	21 (3%)	9 (1%)	1 (0%)	19 (3%)	10 (2%)	1 (0%)	123.5 (67.5)	131.0 (72.5)	8.4 (NA)	7.2 (NA)
Dusch et al.	38 (6%)	21 (3%)	– (NA)	– (NA)	6 (1%)	12 (2%)	– (NA)	– (NA)	– (NA)	– (NA)	– (NA)	– (NA)	84.1 (29.9)	94.8 (26.6)	6.0 (3.7)	6.0 (4.1)
Lopez et al.	5 (1%)	2 (0%)	– (NA)	– (NA)	12 (2%)	13 (2%)	– (NA)	– (NA)	– (NA)	– (NA)	– (NA)	– (NA)	– (NA)	– (NA)	– (NA)	– (NA)
Alvandipour et al.	7 (1%)	8 (1%)	– (NA)	– (NA)	3 (0%)	5 (1%)	– (NA)	– (NA)	– (NA)	– (NA)	– (NA)	– (NA)	71.8 (9)	69.8 (10)	6.6 (1.18)	6.8 (1.53)
O'Leary et al.	5 (1%)	6 (1%)	4 (1%)	0 (0%)	0 (0%)	3 (0%)	– (NA)	– (NA)	– (NA)	– (NA)	– (NA)	– (NA)	71.0 (38.3)	63.1 (15.1)	7.9 (6.3)	8.4 (5.8)
Sureshkumar et al.	2 (0%)	2 (0%)	1 (0%)	1 (0%)	– (NA)	– (NA)	36 (6%)	4 (1%)	0 (0%)	31 (5%)	9 (1%)	0 (0%)	142.1 (NA)	149.5 (NA)	9.9 (NA)	12.0 (NA)

Table 2 (continued)

First author	CSC CVD (% tot)	PS CVD (% tot)	CSC pulmonary (% tot)	PS pulmonary (% tot)	CSC smoke (% tot)	PS smoke (% tot)	CSC ASA 1 (% tot)	CSC ASA 2 (% tot)	CSC ASA 3 (% tot)	PS ASA 1 (% tot)	PS ASA 2 (% tot)	PS ASA 3 (% tot)	CSC time (SD)	PS time (SD)	CSC LOS (SD)	PS LOS (SD)
Ali et al.	9 (1%)	7 (1%)	1 (0%)	0 (0%)	−(NA)	−(NA)	−(NA)	−(NA)	−(NA)	−(NA)	−(NA)	−(NA)	142.0 (7.04)	150.0 (9.85)	5.0 (1.33)	7.0 (1.17)

Circular skin closure (CSC) male male circular skin closure population, *Primary suture (PS) male* male primary suture population, *CSC female* female circular skin closure population, *PS female* female primary suture population, *CSC total* total circular skin closure population, *PS total* total primary suture population, *CSC age (SD)* age of circular skin closure population (standard deviation), *PS age (SD)* age of primary suture population (standard deviation), *CSC BMI (SD)* body mass index of circular skin closure population (standard deviation), *PS BMI (SD)* body mass index of primary suture population (standard deviation), *CSC diabetes* patients with diabetes in circular skin closure population, *PS diabetes* patients with diabetes in primary suture population, *CSC CVD* patients with cardiovascular diseases in circular skin closure population, *PS CVD* patients with cardiovascular disease in primary suture population, *CSC pulmonary* patients with pulmonary diseases in circular skin closure population, *PS pulmonary* patients with pulmonary disease in primary suture population, *CSC smoke* smoking patients in circular skin closure population, *PS smoke* smoking patients in primary suture population, *CSC ASA 1* ASA (American Society of Anesthesiologists) 1 patients in circular skin closure population, *PS ASA 1* ASA 1 patients in primary suture population, *CSC ASA 2* ASA 2 patients in circular skin closure population, *PS ASA 2* ASA 2 patients in primary suture population, *CSC ASA 3* ASA 3 patients in circular skin closure population, *PS ASA 3* ASA 3 patients in primary suture population, *CSC time (SD)* operative time for circular skin closure surgery (standard deviation), *PS time (SD)* operative time for primary suture surgery (standard deviation), *CSC LOS (SD)* length of stay for circular skin closure population (standard deviation), *PS LOS (SD)* length of stay for primary suture population (standard deviation)

the entrapment of bacteria present at the ostomy wound, thereby increasing the risk of surgical site infection in the PS technique [5].

The results obtained from the study are in line with those reported in the literature. McCartan et al. [19] showed a significant reduction in the risk of SSI in 403 patients (two RCTs and three observational studies) undergoing stoma closure if the circular closure technique was used compared to the PS; in particular, the reported reduction in the risk of surgical site infection was 80% (OR 0.083, 95% CI 0.03, 0.21; $p < 0.001$). Rondelli et al. [20] analyzed five randomized clinical trials involving a total of 385 patients undergoing stoma closure and found that the incidence of SSI showed a statistically significant absolute risk difference of −0.24 (95% CI -0.32, -0.15; $p < 0.00001$) favor of the CSC over the PS. Similar results were reported by Hajibandeh et al. [21] in a meta-analysis including six RCTs and eight observational studies involving a total number of 1102 enrolled patients; in that study, the superiority of CSC over PS was confirmed in terms of SSI (OR 0.10, 95% CI 0.06, 0.18; $p < 0.00001$). Gachabayov et al. included 1812 patients [22] who underwent loop ileostomy closure only (six RCTs, and 14 observational studies) and found that the circular technique proved better in preventing SSI compared to the PS (OR 0.14, 95% CI 0.09, 0.21; $p < 0.0001$). The strength of the current systematic review is that only high-quality randomized trials were included, avoiding combining observational and RCTs, a practice discouraged by the Cochrane Handbook [23].

The CSC technique is also strongly recommended by Italian guidelines for the surgical management of enteral stomas in adults; the purse-string closure is recommended over other techniques to reduce SSI rate (strong recommendation based on high-quality evidence, GRADE 1A) [24].

No further differences between the two techniques were detected regarding operative time, LOS, and risk of incisional hernia in line with the results reported by previous meta-analyses.

Readers are advised to interpret the analysis on incisional hernia with caution. Although the reduction of SSIs may theoretically reduce the rate of incisional hernia, no statistical differences among this outcome were detected (OR 0.65, 95% CI 0.24, 1.81). Several factors might be involved in the incidence and detection of hernia after surgery, and this outcome is poorly investigated and included studies lacking adequate information on this outcome. In fact, incisional hernia was only reported in four studies [12, 13, 16, 17], with a short follow-up (3–12 months) and it was mostly assessed only by clinical examination. This might cause an underestimation of the actual rates and justify the conflicting results observed in some studies (e.g., higher incisional hernia rate in the PSC group reported in the Dusch study [13]), which are difficult to explain. In addition, even RCTs might

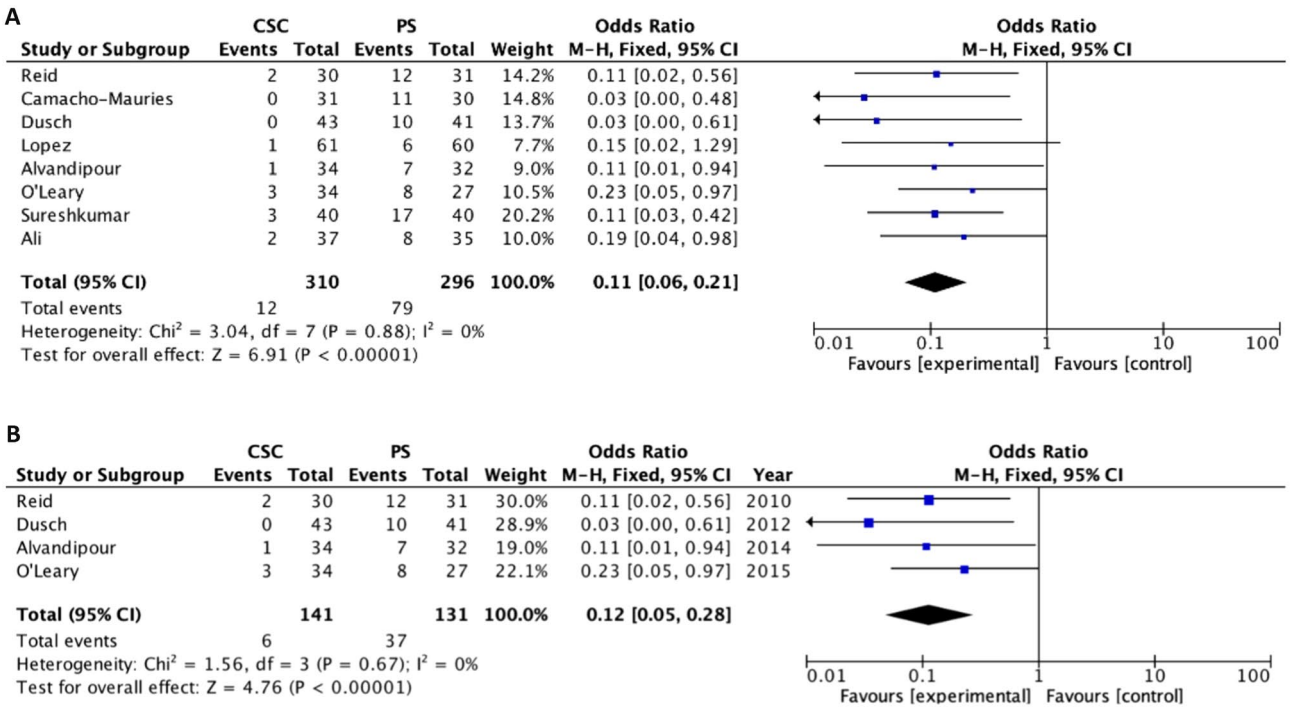

Fig. 2 Meta-analysis of risk of SSI

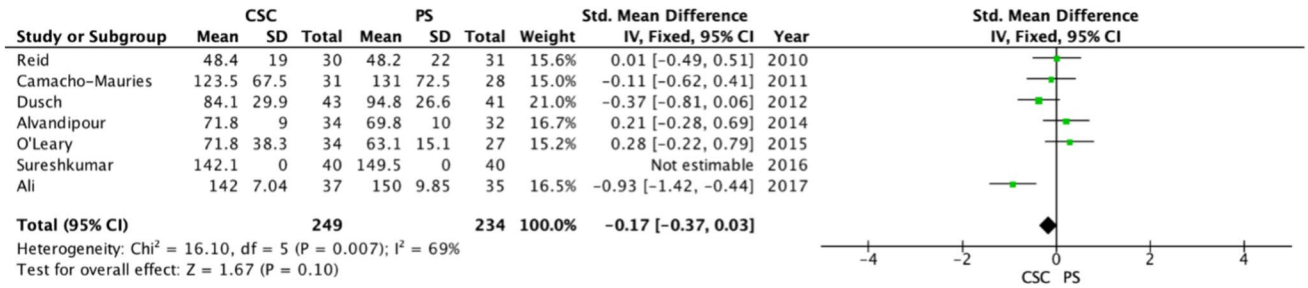

Fig. 3 Meta-analysis of operative time

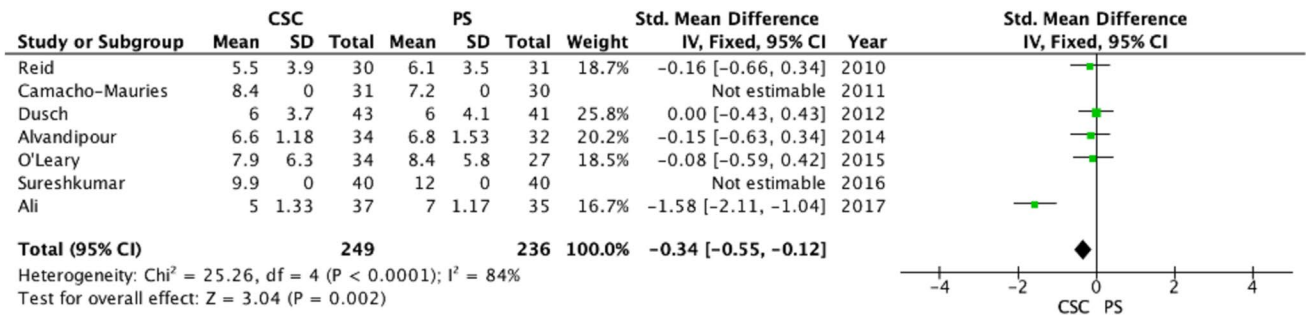

Fig. 4 Meta-analysis of LOS

not be ideal to assess this, as they are mostly based on SSI and therefore might be underpowered to detect a difference in incisional hernia rates.

A better cosmetic result in wound healing with higher patient satisfaction after CSC has been claimed, but it is still controversial. Three RCTs [12, 14, 17] reported higher

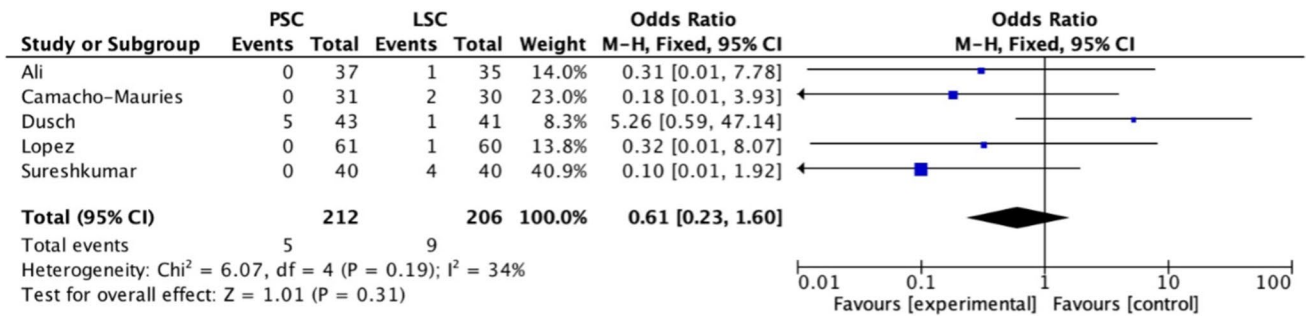

Fig. 5 Meta-analysis of incisional hernia

Fig. 6 Risk of bias according to RoB2 tool

patient satisfaction in the CSC group: Camacho-Mauries et al. [12] reported that 75% of patients in the CSC group were very satisfied with the type of suture versus only 20% in the PSC group ($p=0.0001$); in addition, 93% of patients in the CSC group reported a rating of 8 to 10 on the VAS scale versus 3% of patients undergoing PSC ($p=0.0001$). Again, the cosmetic result of skin closure is more appreciated in patients undergoing CSC than PSC in both the study by Alvandipour et al. ($p<0.001$) [14] and the study by Ali et al. ($p=0.001$) [17]. Other studies [11, 13, 15, 16] failed to demonstrate any difference regarding body image, cosmesis, POSAS, or VAS at the follow-up appointments.

A modification of the CSC defined as the "gunsight" technique [25] has also been proposed: the skin incision is enlarged by the removal of four triangular skin flaps which are subsequently closed again with a purse suture to give a small and neat scar which allows for some central drainage. The name of the technique derives from the viewfinder shape that the wound assumes as result of the technique. A randomized clinical trial performed by Han et al. [26] highlighted a low rate of SSIs and incisional hernia also for this technique when compared with CSC, with advantages as regards wound cosmetics and wound healing time at the expense of an increase in operative time. However, further studies are needed to confirm these results.

The strong methodology of this meta-analysis is sufficient to state that CSC should be considered the gold standard technique in the closure of the skin (and subcutaneous tissue) in the stoma closure. The considerable reduction in the risk of infection of the surgical site is definitively demonstrated, combined with an equal risk of incisional hernia, with similar operative time and length of stay. All the studies considered are RCTs ensuring a high quality of the meta-analysis performed; however, some biases remain linked to the fact that not all studies reported data such as comorbidities (diabetes, cardiovascular diseases, lung diseases, etc.), smoking status, and the anesthetic risk (ASA) of patients, and therefore not being able to be certain of perfect homogeneity of the population studied. About the data period for the study inclusion, a period starting from 2010 was chosen to reduce further biases deriving from the modification of the medical therapy (i.e., biologicals, preoperative radiotherapy) for the different types of pathologies that can lead to the creation of a stoma in a patient.

Conclusion

This meta-analysis found that CSC is associated with a significant reduction in SSI in patients undergoing ileostomy or colostomy closure. The evidence obtained is solid and allows one to conclude that it should become the gold standard for skin closure after stoma reversal.

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Data availability No datasets were generated or analysed during the current study. Data available within the article.

Declarations

Conflict of interest The authors declare no competing interests.

Ethical and Informed consent The authors did not perform any procedure on patients in this study.

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