

**REVIEW ARTICLE**

# Comparing running vs interrupted sutures for skin closure: A systematic review and meta-analysis

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**Abstract**

Continuous sutures and interrupted sutures have been widely applied to skin closure after non-obstetric surgery or traumatic wounds. Usually, continuous sutures were divided into transdermal or subcuticular sutures according to whether the stitches were placed through or below the epidermal layer. Interrupted sutures, on the other hand, involved penetration of the loose connective tissue beneath the skin layers, with stitches placed through the external skin layer. Complications including infection, dehiscence, and poor cosmetic appearance were not rare after suturing. Whether a suture method is a suitable option for rapid wound healing and long-term cosmetic appearance remains controversial. To examine the potential benefits and harms of continuous skin sutures vs interrupted skin sutures in non-obstetric surgery or traumatic wounds. Searching websites such as PubMed, the Cochrane Central Library, Web of Science and Embase, and [ClinicalTrials.gov](https://clinicaltrials.gov) were systematically searched up to 5 January 2022 and were assessed and guided by Preferred Reporting Items for Systematic Reviews and Meta-analysis rules as well as guidelines. All relevant randomised controlled studies comparing continuous sutures with interrupted sutures of skin closure were analysed. The suture techniques and material used in each trial were recorded. The transdermal and subcuticular continuous sutures were separately compared with interrupted sutures in the subgroup analysis of dehiscence and cosmetic appearance because the visual appearance of these two continuous suturing techniques was significantly different. Ten studies including 1181 participants were analysed. Subcuticular continuous sutures had comparatively higher visual analogue scale (VAS) scores among patients and doctors than interrupted sutures (OR = 0.27, 95% Confidence Intervals [CI] = 0.07-0.47,  $P < .01$ ). Similarly, priority was found regarding transdermal continuous sutures and interrupted sutures (OR = 0.40, 95% CI = 0.21-0.60,  $P < .01$ ). Five randomised controlled trials (RCTs) demonstrated relevant data about dehiscence events. The incidence of continuous suture was significantly lesser than that of interrupted suture (OR = 0.16, 95% CI = 0.07-0.37,  $P < .01$ ). There was no significant difference

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between the infection events rates of two suture methods (OR = 0.69, 95% CI = 0.40-1.21,  $P = .62$ ,  $I^2 = 0\%$ ). This systematic review indicated the superiority of both transdermal and subcutaneous continuous sutures over interrupted sutures in skin closure in terms of wound healing and cosmetic appearance.

#### KEYWORDS

complication events, continuous suture, cosmetic appearance, interrupted suture, wound healing

#### Key Messages

- This meta-analysis and systematic review demonstrated the superiority of continuous suture over interrupted suture in skin closure in terms of wound healing and cosmetic appearance.
- To our knowledge, this is the first meta-analysis providing insight into whether continuous skin sutures result in a better cosmetic appearance.
- Our research demonstrates that the use of continuous suturing reduces superficial wound dehiscence and improves cosmetic satisfaction. We recommend that clinicians place more emphasis on continuous sutures when both suturing techniques are available for skin wound closure. When dealing with skin closure in high tension areas, an intracutaneous continued suture is a better method to reduce the complications of the wound opening. In terms of the scar cosmetic appearance, running suturing is also more appealing for both surgeons and patients.

## 1 | INTRODUCTION

Skin suturing is one of the basic procedures in all surgeries. It promotes early wound healing, which is an essential process of scar formation. The permanent scar formed after wound healing will significantly affect the mental health, personal relationships, and quality of life of patients.<sup>1</sup> According to Moy et al, the ideal skin suture is rapid and straightforward, providing sufficient tensile strength to the wound until it heals, and the wound edges are accurately anastomosed to avoid scar hyperplasia.<sup>2</sup> The appropriate suture can reduce wound complications and scar hyperplasia, therefore achieving better cosmetic outcomes.<sup>3</sup>

Suture methods can be basically categorised into two groups: continuous sutures and interrupted sutures. When using interrupted sutures, surgeons can control the suture spacing between two ends of the wound because each stitch is composed of a single piece of material. By comparison, continuous sutures have the nature of having uniform tension during the whole length of the wound.

The short-term complications after skin suture include dehiscence and infection. Most studies on sutures have focused on infection because it is the most common complication in all operations.<sup>4</sup> Disinfection, antibacterial treatment, and infection prevention are essential in all surgeries. With the development of surgical skills and long-term complications, scar appearance and pigmentation development

are also raising both surgeons' and patients' concerns. Most of the outcome reports on the cosmetic evaluation of scars are based on subjective scar scores. The visual analogue scale (VAS) is a reliable and effective instrument for measuring differences and changes in scar quality.<sup>5</sup>

Apart from continuous or interrupted techniques, the skin layers involved (transdermal or subcuticular) and suture material used may also play essential roles in the outcomes. In general, interrupted sutures involve the whole skin layer. Continuous subcutaneous sutures, contrasting with continuous transdermal sutures, were stitches placed immediately below the external skin layer and offered benefits of better aesthetic outcomes.<sup>6</sup> Dehiscence rate remained unclear whether subcutaneous or transdermal sutures would be different.<sup>7</sup> For these reasons, we carry out a subgroup analysis to separately compare continuous subcutaneous or transdermal sutures with interrupted sutures in this study. The infection rate was similar in subcutaneous and transdermal continuous sutures,<sup>8,9</sup> so they were analysed within the same group. Sutures materials can be divided into two main types, absorbable or non-absorbable. Continuous suture materials are absorbable, while interrupted sutures are mostly unabsorbable.<sup>10</sup> The suture material seemed to be linked with the choice of suture technique. Given that there was evidence showing no significant differences in two suture materials in the incidence of complication events and

cosmetic appearance,<sup>11-13</sup> the primary determinant is still the method of skin closure.

Current researchers had conflicting opinions when comparing the two suture methods. For instance, some surgeons believed interrupted sutures had the advantage of providing more tensile strength and thus less dehiscence.<sup>14</sup> However, some argued that interrupted sutures would develop dehiscence if the wound edges were overlapped.<sup>10</sup> Therefore, which suture method is more suitable for wound suture remains controversial. This study searched randomised controlled trials (RCTs) comparing continuous sutures and interrupted sutures. We discussed the differences in the incidence of infection and dehiscence, cosmetic outcome, and suturing time between the two suture methods to offer a proposal for surgeons in suture methods.

## 2 | METHODS

This study was directed by the rules of the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) statement.<sup>15</sup>

### 2.1 | Search selections

Relevant studies from PubMed, the Cochrane Central Library, Embase, and Web of Science to 5 January 2022 were searched. Moreover, we conducted a manual search of all relevant references in the literature. For those relevant databases, we used the search strategy about the medical subject headings (MESH): 'Suture Techniques', 'interrupted suture', 'continuous suture', 'running suture', 'suture', 'suturing', 'comparative study', 'prospective studies', 'clinical trial', 'randomized/randomized controlled study' and 'Human'. The language was restricted to English only. We strictly limit searched articles to RCTs. All potentially eligible studies were performed and checked by two researchers independently. Disagreements and controversies between reviewers were discussed and resolved by collective consensus.

### 2.2 | Inclusion and exclusion criteria

#### 2.2.1 | Inclusion criteria

1. Study type: RCTs published in full peer-reviewed journals up to 5 January 2022 were included in the analysis.
2. Language: Only English articles were included.
3. Intervention: Two different suture techniques for skin suture, continuous suture (both transdermal and subcutaneous) vs interrupted suture, were assessed for

the short-term and long-term differences in surgical outcomes. Suture material could be different. The issues of difference between subcutaneous and transdermal continuous sutures in dehiscence rate and cosmetic appearance were resolved by subgroup analysis.

4. Included patients: Patients who needed skin sutures for traumatic wounds or non-obstetric surgery were included in the meta-analysis.

#### 2.2.2 | Exclusion criteria

1. Not RCTs or studies unpublished were excluded.
2. Suturing techniques are applied not for skin closure, such as in obstetric surgery and abdominal fascial closure.
3. Without relevant outcome.

### 2.3 | Outcomes of analysis

The primary outcome measure included (a) VAS of the scar cosmetic appearance after long-term follow-up, evaluated by both professional doctors and patients; (b) the incidence of dehiscence; and (c) the infection rate. The secondary outcome measure was the suturing time. Other outcome variables, such as edema intensity, hospital stay, and pain intensity, were not analysed because of insufficient data.

### 2.4 | Data collection

We extracted the baseline characteristics and outcome information: the first author, published the year of study, type of surgery, number of participants, suture techniques, suture methods, suture material, and all the relevant outcomes. The information was extracted from included RCTs and double-checked by two individuals. If there are controversies, a third reviewer will reach the final discussion until we agree.

### 2.5 | Quality of evidence assessment

Two independent authors reviewed all RCTs. They assessed the quality and eligibility of the selected studies blindly, according to the guidelines of the Critical Appraisal Skills Programme (CASP) Checklist. If they cannot reach a consensus, we establish a group discussion with a third assessor. The CASP Checklists assess the bias risk and comprise 11 items for evaluation (Table S1). Each study was allocated a score from 0 to 11, with 0 representing the lowest quality and 11 representing the highest based on the following

aspects: reporting of randomization, blinding, methodological quality, and statistical reporting. Each item was scored 1, 0.5, and 0 to represent the meaning of 'Yes', 'Not sure', and 'No', with a maximum score of 11. Trials with a score of over 8 were regarded as high-quality RCTs.

## 2.6 | Statistical data analysis

We used the newest version of analysis software: Cochrane Collaboration's Review Manager Program (RevMan version 5.4; Cochrane Collaboration, Oxford, UK). For continuous data, the mean and deviation of each study are required. We analysed the odds ratios (ORs) with 95% CIs. Tests of heterogeneity ( $I^2$  index) for outcomes were performed. When discussing the incidence of dehiscence and cosmetic appearance, the difference of continuous transdermal or subcutaneous sutures vs standard interrupted sutures was separately investigated in subgroup analysis. Fixed-effects or random-effects models were used accordingly to combine the summary data. We analysed the publication bias by funnel plots. Statistical heterogeneity was tested with the  $\chi^2$  test and  $I^2$   $P$  values for tests of hypotheses on the study variables were reported. The effect was statistically significant if the  $P$ -value was  $\leq 5\%$ .

## 3 | RESULTS DEMONSTRATION

A flow-process diagram of the article search is demonstrated in Figure 1. First and foremost, through the direction of the database search strategy, we identified 49 478 potentially eligible articles. Non-RCTs were excluded in the first move, leaving 1992 articles. Then those 1992 articles were further selected after careful reading of the abstracts. Among the process, 1910 articles were excluded because comparisons of suture materials or other suture techniques were made instead of continuous and interrupted sutures. After thorough and detailed insights into these 82 full-text articles, 18 studies were eliminated because participants were women after vaginal birth or perineal injuries, 32 studies of fascial, soft tissue, vascular or muscle suturing, and 7 studies of corneal suturing were excluded. Eleven studies were excluded because comparisons were not made between continuous sutures and interrupted sutures, 2 studies were excluded because the original manuscripts were retrieved, and 1 study was excluded because it was not written in English. Two studies were further excluded because of lack of relevant outcomes. The remanent 10 RCTs were eventually brought into the final meta-analysis.

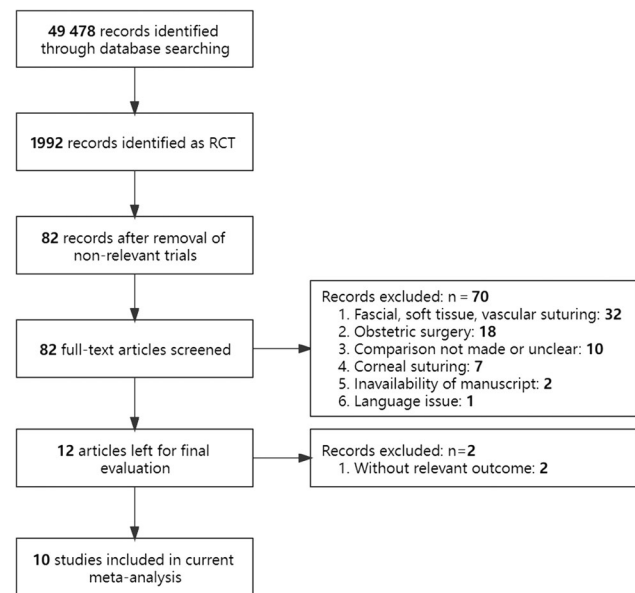


FIGURE 1 Flow diagram of the bibliographic search

## 3.1 | Study characteristics

The basic information and characteristics of the selected RCTs are presented in Table 1. Our systematic review and meta-analysis included 1181 participants. Among them, 529 patients were treated with continuous sutures, 551 patients were treated with interrupted sutures, and 101 patients were treated with both continuous sutures and interrupted sutures for half of the end of the same scar. The suturing technique and suture material are depicted in Table 2. Two trials compared continuous epidermal sutures and standard interrupted sutures. The left 8 trials studied intradermal/subcutaneous continuous sutures and interrupted sutures. Only one trial involved interrupted Donati stitches. In terms of suturing material, continuous sutures were likely to be absorbable, while interrupted sutures were generally non-absorbable. The quality evaluation of all included trials is demonstrated in Table 3.

## 3.2 | Primary outcomes

### 3.2.1 | Subgroup analysis of VAS

Six of the articles reported the VAS evaluation. In order to eliminate the influence and interference of the skin suture layer on appearance, we performed the subgroup analysis to exclude the interference factors and strongly prove the influence of suture mode on aesthetics. Four articles regarding the VAS evaluation between subcuticular or intradermal continuous sutures and traditional interrupted sutures found that continuous sutures

TABLE 1 Baseline information of randomised controlled trials (RCTs) enrolled in the meta-analysis

Study (Ref.)	Trial design	Type of surgery	Suturing place	Sample size	Drop-out rates	Sample size
Boutros S (2000)	RCT	Laceration and traumatic wounds repairing and closure	Scalp, face, upper extremity, lower extremity	119	6/101	Total = 95, Continuous = 42, Interrupted = 53
Anne K (2014)	RCT	Open acute appendicitis	Abdominal	206	51/193	Total = 137, Continuous = 69, Interrupted = 68
S Kot (2012)	RCT	Open appendectomy	A lower right abdominal incision	206	21/206	Total = 185, Continuous = 90 Interrupted = 95
Marco M (2014)	RCT	Sacrococcygeal pilonidal sinus	Sacral place	214	11/214	Total = 203; continuous = 100; interrupted = 103
Paul G. (1995)	RCT	Bypass surgery with a groin incision	Groin wounds	79	0/79	Total = 79, Continuous = 38, Interrupted = 41
Torben B (2009)	RCT	Single-portal endoscopic release of the carpal tunnel	The palmar side of the wrist	58	4/58	Total = 54, Continuous = 28, Interrupted = 26
Xiaomeng L (2017)	RCT	Conventional excision or Mohs micrographic surgery (MMS)	Face	142	13/142	Total = 129, Continuous = 62, Interrupted = 67
Marie-Michele Blouin (2015)	RCT	Mohs micrographic surgery (MMS)	face	105	4/105	total = 101 (one person with both continuous and interrupted)
SL Pauniah	RCT	Appendectomies with open technique	abdominal	198	28	Total = 198, continuous = 100, interrupted = 98
Judith D (2006)	RCT	A laparotomy for gynaecological diseases	lower midline abdominal	80	10/80	Total = 70; continuous = 37; interrupted = 33

have a comparatively higher VAS among patients and doctors than interrupted sutures (Std. Mean Difference = 0.27, 95% CI = 0.07-0.47,  $P < .01$ ). Two articles regarding transdermal continuous sutures and standard interrupted sutures found a similar priority of continuous sutures (Std. Mean Difference = 0.40, 95% CI = 0.21-0.60,  $P < .01$ ). Overall, continuous sutures have a comparatively higher VAS among patients and doctors than interrupted sutures (Std. Mean Difference = 0.34, 95% CI = 0.20-0.47,  $P < .01$ ; Figure 2).

### 3.3 | Dehiscence

Five RCTs reported relevant data regarding dehiscence events. Subcutaneous continuous sutures were better

in reducing the incidence of dehiscence events (OR = 0.16, 95% CI = 0.07-0.37,  $P < .01$ ; Figure 3). Subgroup analysis was not conducted for lack of trials comparing continuous transdermal sutures and interrupted sutures.

### 3.4 | Infection events

The infection rates were reported in 9 RCTs. The overall infection rate was 4.4% (3.6% in the continuous suture group and 5.2% in the interrupted suture group). We did not find a significant difference in the infection rate between continuous sutures and interrupted sutures (OR = 0.69, 95% CI = 0.40-1.21,  $P = .62$ ,  $I^2 = 0\%$ ; Figure 4).

TABLE 2 Suture techniques and suture material of continuous or interrupted sutures in randomised controlled trials

Study	Skin layer	Continuous sutures technique	Interrupted sutures technique	Continuous suture material	Interrupted suture material
Anne K (2014)	Subcuticular	Continuous intradermal suture	Normal interrupted suture	Monocryl absorbable 4-0 monofilament suture	Ethilon non-absorbable 4-0
Judith D (2006)	Subcuticular	Continuous intradermal suture	Interrupted Donati stitches (vertical mattress stitches)	Monocryl 3-0	Ethilon 3-0
Marco M (2014)	Cuticular	Simple running suture	Normal interrupted suture	Absorbable 2-0 (Polyglytone 6211)	non-absorbable 2-0 (polyester)
M Blouin (2015)	Cuticular	Simple running suture	Normal interrupted suture	Vicryl/Ethicon 4-0 or 5-0 polyglactin 910	Vicryl/Ethicon 4-0 or 5-0 polyglactin 910
Torben B (2009)	Subcuticular	Subcuticular continuous suture	Normal interrupted suture	Caprosyn absorbable 4-0 polyglactin 6211 monofilament suture	Novafil non-absorbable 5/0 monofilament polybutester
Xiaomeng L (2017)	Subcuticular	Running subcuticular suture	Normal interrupted suture	non-absorbable monofilament sutures	non-absorbable monofilament sutures
Pauniah (2010)	Subcuticular	Continuous intradermal suture	Normal interrupted suture	absorbable 4-0 polyglactin 910	non-absorbable 4-0 braided nylon sutures
S Kot (2012)	Subcuticular	Continuous intradermal suture	Normal interrupted suture	Monocryl absorbable 4-0 monofilament suture	Ethilon non-absorbable 4-0
Paul G (1995)	Subcuticular	continuous intradermal suture	Normal interrupted suture	Nylon (details not mentioned)	Nylon (details not mentioned)
Boutros S (2000)	Cuticular or subcuticular	Simple or subcuticular continuous suture	Normal interrupted suture	Nylon (details not mentioned)	Nylon (details not mentioned)



TABLE 3 Quality evaluations of randomised controlled trials finally included in the meta-analysis

Reference	Score of item I	Score of item II	Score of item III	Score of item IV	Score of item V	Score of item VI	Score of item VII	Score of item VIII	Score of item IX	Score of item X	Score of item XI	Total scores
Boutros S (2000)	1	0.5	1	0.5	0.5	0	1	1	1	1	1	8.5
Anne K (2014)	1	1	1	1	0.5	0	1	1	1	1	1	9.5
S Kot (2012)	1	1	1	1	0.5	0	1	1	1	1	1	9.5
Marco M (2014)	1	1	0.5	1	0.5	0	1	1	1	1	1	9
Judith D (2006)	1	1	0.5	1	0.5	0	1	1	1	1	1	9
Paul G (1995)	1	0.5	0.5	1	0.5	0	1	0.5	1	1	1	8
Torben B (2009)	1	1	0.5	0.5	0.5	0	1	1	1	1	1	8.5
Xiaomeng L (2017)	1	1	1	1	0.5	0	1	1	1	1	1	9.5
M Blouin (2015)	1	1	1	1	0.5	0	1	1	1	1	1	9.5
Paumiaho (2010)	1	1	0.5	1	0.5	0	1	1	1	1	1	9

### 3.5 | Potential publication bias

A funnel plot regarding the (a) VAS score, (b) the incidence of dehiscence, and (c) infection events are demonstrated in Figure 5, respectively. No apparent asymmetry was shown through the funnel plot, and only one study lays outside the limits of the 95% CI for dehiscence, and two studies lay outside for the VAS. No significant publication bias was noticed as all the studies were limited to other events.

## 4 | DISCUSSION

Our study compared the clinical and cosmetic outcomes of continuous and interrupted skin sutures. A total of 1181 participants in 10 independent RCTs were included in this meta-analysis and systematic review.<sup>10,16-24</sup> All the participants underwent traumatic wound repair or non-obstetric surgical skin closure. The sutures were at the scalp, face, upper or lower extremities, wrist, abdominal wall, groin area, or sacral region. Percutaneous or subcutaneous continuous sutures were separately analysed and compared with conventional interrupted sutures. The primary outcomes were infection, wound dehiscence, and cosmetic appearance VAS by both observers and patients. As mentioned above, suture material was not considered a potential bias as they have proven to have limited influence on primary outcomes.<sup>11-13</sup>

Overall, a total of 9 trials reported superficial wound infection. The infection was diagnosed by observing clinical signs and symptoms, such as redness, edema, discharge, or positive bacterial culture. A recent meta-analysis has showed no apparent difference between subcutaneous skin closure and no subcutaneous skin closure in developing wound infection.<sup>9</sup> Thus, subgroup analysis was not conducted. Our result indicated no significant difference in the proportion of participants between the two intervention groups. Notably, there was also no significant result in each trial. Therefore, suturing techniques have a slight impact on the incidence of superficial surgical site infection. Nevertheless, continuous sutures still have limitations. Once infection occurs, the whole stitch needs to be removed, hindering the healing process.<sup>25-27</sup> Pus could be drained by selectively removing a single stitch in interrupted sutures.

Participants in five different trials developed superficial wound dehiscence. The definition of dehiscence was not defined, although some experts described it as wounds open over 1 cm in one of the trials.<sup>18</sup> Overall, the difference between the two groups was significant, indicating that interrupted sutures were more likely to develop wound dehiscence than continuous subcutaneous sutures. The

difference was significant in 4 independent trials involving the abdominal wall.<sup>10,18,20,21</sup> The difference was not significant when the wound was sutured on the face.<sup>22</sup> A possible explanation is that in surgical wounds with high tensions, such as the scalp, abdominal wall, or extremities, interrupted sutures may have difficulty closing a defect when used under high stress on the skin because the wound edges have excessive tension.<sup>28,29</sup> The facial area (especially

when the wound area is limited) is considered less tension, leading to no difference in the incidence of wound dehiscence between the groups. The possible explanation for the difference between the two groups is the overlapping of the wound edges caused by interrupted sutures, which continuous subcutaneous sutures can avoid. We may consider multiple factors concerning the reason for wound opening. More studies are needed to demonstrate the theories.

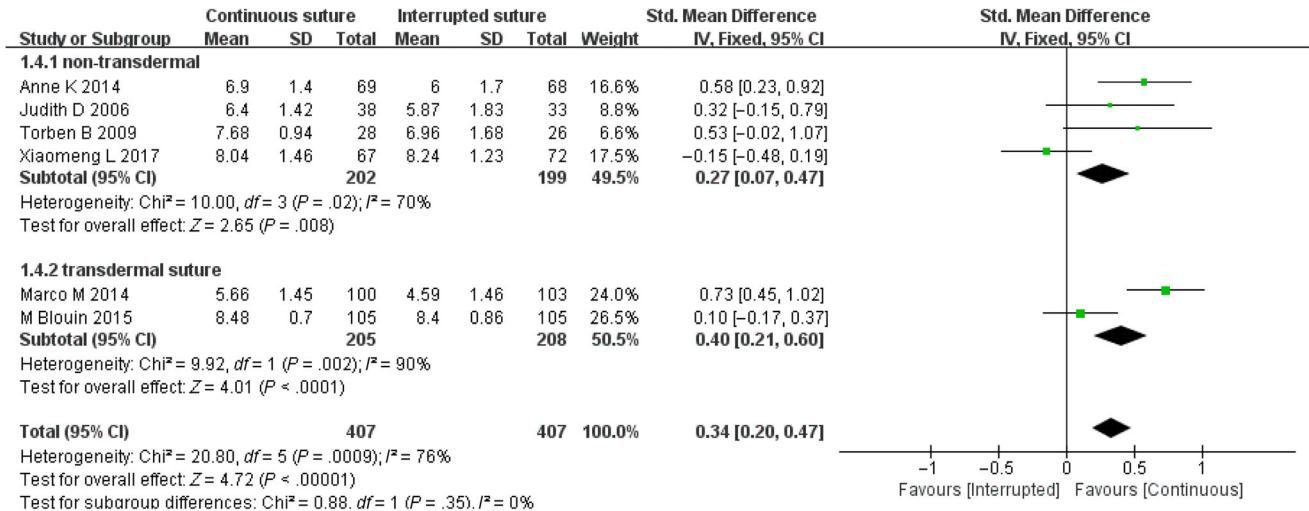


FIGURE 2 Forest plot of visual analogue scale subgroup analysis

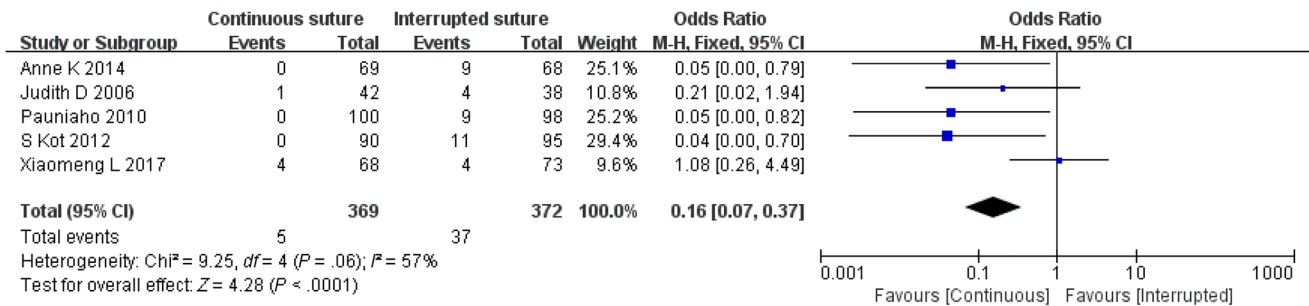


FIGURE 3 Forest plot of dehiscence events

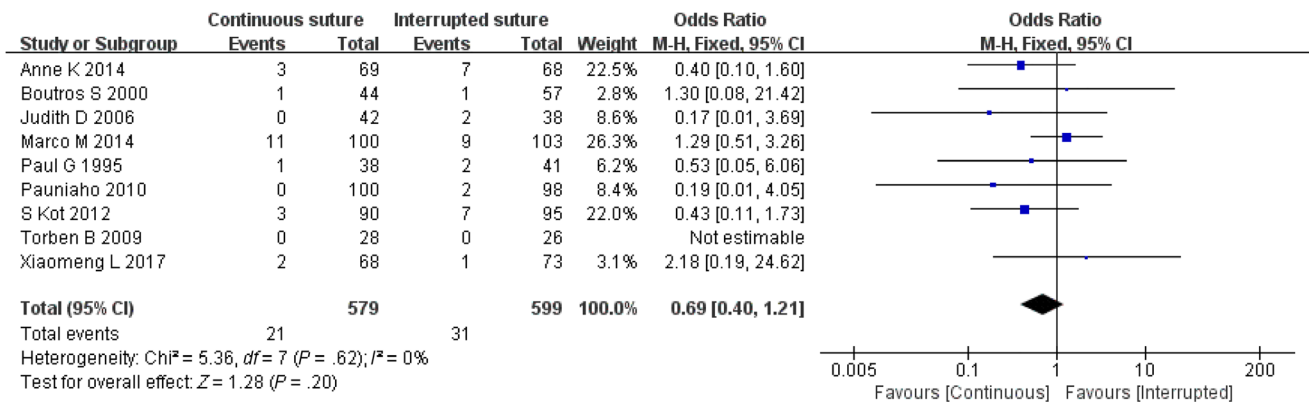


FIGURE 4 Forest plot of infection events



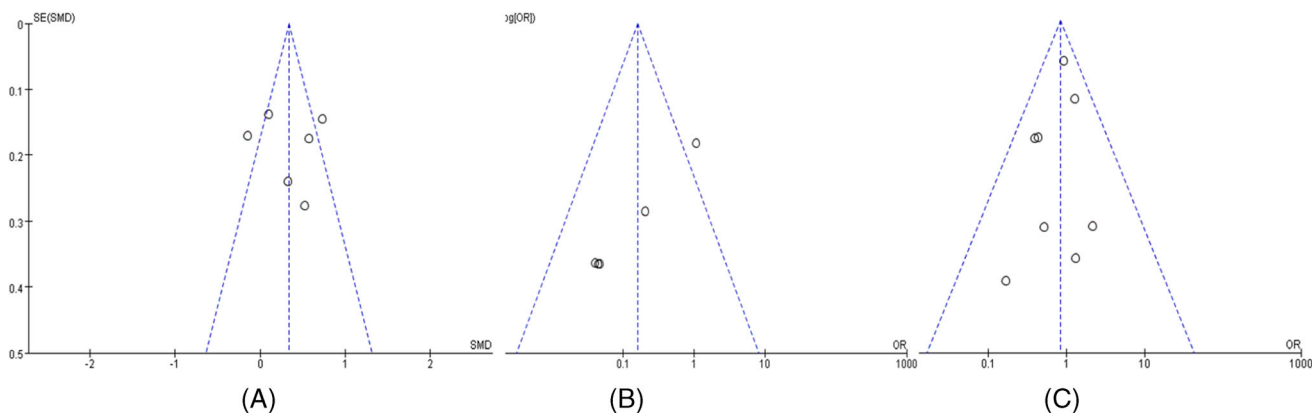


FIGURE 5 Funnel plot of (A) visual analogue scale score, (B) incidence of dehiscence, and (C) infection events

Previous studies investigating the association between suture techniques and cosmetic outcomes are limited. However, cosmetic satisfaction is sometimes even more important than the functional outcome of treatment,<sup>30</sup> playing an essential role in every aspect of our social life.<sup>1</sup> The VAS score of scar cosmetic appearance was reported in six trials by either professional observers or participants. We found that the cosmetic appearance was superior to continuous sutures, whether subcutaneous or percutaneous. Only one trial suggested that interrupted suture was slightly more relevant to a cosmetically superior outcome, with no significant importance.<sup>22</sup> The primary determinant of the cosmetic appearance of the scar in the paper is the method of skin closure.<sup>31</sup> It is generally believed that suture marks are associated with tissue inflammation macroscopically<sup>31</sup> and collagen fibre breakage<sup>32</sup> microscopically. Continuous subcutaneous sutures do not have stitches over the epidermal layer, resulting in no punctate scarring. In non-subcutaneous subgroup analysis, simple interrupted sutures, different from percutaneous running sutures, have to penetrate the epidermis to cause more inflammation. Continuous cutting and compression of soft tissue under normal skin can increase fibrous tissue during healing and centipede-like scarring. In addition, the suturing depth, width, and tensile strength might be difficult to be even because of the use of separate stitches, contributing to less precise epidermal alignment and a weakened cosmetic result.<sup>2,32</sup> The likelihood of dehiscence or the development of cross-scarring caused by interrupted suture may also affect the cosmetic result.<sup>21,33</sup>

The aesthetic evaluation of a scar is complicated. Several well-established scales that evaluate postsurgical scars have been applied to clinical practice.<sup>34</sup> Unfortunately, fewer than three pieces of work use these rating scales for primary outcomes. We used VAS as an alternative, consisting of a visual analogue cosmetic scale

marked ‘best-looking scar’ at the top end and ‘worst-looking scar’ at the low end. Some may argue that the VAS assessment system is relatively arbitrary and subjective. However, a previous study showed an interobserver agreement of 0.75 to 0.87.<sup>18</sup> Additionally, good concordance between physician and patient assessments of scars has been demonstrated.<sup>35</sup> As both professional observers and patients evaluated the outcome on the same assessment scale, they were all included in the analysis.

Previous reviews have mainly concentrated on continuous vs interrupted sutures in obstetric surgery or episiotomy repair.<sup>36,37</sup> Suturing techniques usually require perfect closure of perineal muscle and soft tissue prior to skin closure. We excluded these studies because the different suturing techniques in soft tissue and muscle layers may cause bias. We also excluded abdominal fascia sutures in our study for the same reason.

To our knowledge, this is the first meta-analysis providing insight into whether continuous skin sutures result in a better cosmetic appearance. A relevant meta-analysis was reported in 2014 and included five independent studies.<sup>38</sup> Only two of the trials used the method of randomization and were also included in our study. The cosmetic results were not investigated because of the small number of articles included.

Our research demonstrates that continuous sutures reduce superficial wound dehiscence and improve cosmetic satisfaction. We recommend that clinicians emphasise continuous sutures when both suturing techniques are available for skin wound closure. When dealing with skin closure in high tension areas, subcutaneous continuous sutures are superior in reducing the complications of the wound opening. Running sutures are also more appealing for both surgeons and patients in terms of the scar cosmetic appearance. Continuous sutures are also time-saving in clinical routine.<sup>39</sup> One of the significant limitations of our study is that the trials in our VAS

subgroup analysis are limited, especially in the percutaneous group. Besides, we fail to conclude our outcome with more specific and comprehensive scar evaluation systems. The validity of the scar assessment needs to be improved by further studies.

Other complication events, such as symptoms of edema, swelling, pain and itchy and development of keloid scarring, hypertrophy and pigmentation, remain to be discussed. Recent trials have been carried out using a colourimeter to compare the colour difference between the suture area and the patient's own colour.<sup>22,40</sup> It is considered a more objective method to evaluate the intensity of edema and the development of pigmentation. Future trials with more extended follow-up periods are needed to assess the impact of the difference in skin suturing techniques from a more comprehensive perspective.

### AUTHOR CONTRIBUTIONS

Wenhao Luo and Yinjie Tao contributed equally to this article. Study design: Wenhao Luo; Literature search: Yawen Wang and Zhaolian Ouyang; Study selection: Wenhao Luo, Yinjie Tao, Yawen Wang; Study draft and revision: Wenhao Luo, Yinjie Tao and Yawen Wang; Article guarantor: Dr Jiuzuo Huang and Dr Xiao Long; Project administration and Supervision: Dr Jiuzuo Huang and Dr Xiao Long.

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### CONFLICT OF INTEREST

The authors declare no conflicts of interest.

### DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

### CONSENT TO PUBLISH

We exceedingly hope that this manuscript can be accepted and published.

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## SUPPORTING INFORMATION

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