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REVIEW ARTICLE

Incision and drainage of cutaneous abscess with or without cavity packing: a systematic review, meta-analysis, and trial sequential analysis of randomised controlled trials

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Abstract

Aims To evaluate comparative outcomes of incision and drainage of cutaneous abscess with and without packing of the abscess cavity.

Methods A systematic search of multiple electronic data sources was conducted, and all randomised controlled trials (RCTs) comparing incision and drainage of cutaneous abscess with and without packing were included. Abscess recurrence at maximum follow-up period, need for second intervention, and development of fistula in-ano were the evaluated outcome parameters for the meta-analysis A Trial Sequential Analysis was conducted to determine the robustness of the findings.

Results Eight RCTs reporting a total number of 485 patients who underwent incision and drainage of cutaneous abscess with (n = 243) or without (n = 242) packing of the abscess cavity were included. There was no significant difference in the risk of recurrence (risk ratio (RR) 1.31, P = 0.56), fistula-in-ano (RR 0.63, P = 0.28), and need for second intervention (RR 0.70, P = 0.05) between two groups. The results remained unchanged on sub-group analyses for ano-rectal abscess, paediatric patients, adult patients, and the use of antibiotics. The Trial Sequential Analysis demonstrated that the meta-analysis was not conclusive, and the results for recurrence were subject to type 2 error.

Conclusion Incision and drainage of cutaneous abscess with or without packing have comparable outcomes. However, considering the cost and post-operative pain associated with packing, performing the procedure without packing of the abscess cavity may be more favourable. The findings of the better quality ongoing RCTs may provide stronger evidence in favour of packing or non-packing.

Keywords Cutaneous abscess · Incision and drainage · Packing; non-packing

Introduction

Patients with skin and soft tissue infections present commonly to both primary and secondary care [1, 2]. They commonly lead to the formation of a cutaneous abscess. Although cutaneous abscesses can develop on all parts of the body, they are most common in the axillae, buttocks, perineum, groin, or breasts [3, 4].

Incision and drainage of a cutaneous abscess under either local or general anaesthesia is considered the gold standard treatment for cutaneous abscess [5, 6]. Traditionally, following the incision and drainage of an abscess, the abscess cavity is packed with an iodine swab or alginate dressing in order to not only allow healing by secondary intention but also prevent an early recurrence [3, 7–10]. Moreover, the packing is believed to absorb any remaining exudate, prevent infection, provide haemostasis in the initial stages, and prevent the incision from premature closure, thus allowing adequate drainage [10]. When the pack is used, it may require regular review and replacement in the community by a health care professional [9, 10].

Several studies questioned the 'traditional' practice of packing a cutaneous abscess cavity following the surgical

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drainage as such approach may be associated with higher post-operative pain, particularly in children, and need for analgesia with no significant decrease in the risk of recurrence [11–13]. Moreover, the practice of packing is associated with a considerable financial burden and the use of scarce healthcare resources [14].

We aimed to perform a comprehensive literature search and conduct a meta-analysis to compare outcomes of incision and drainage of cutaneous abscess with or without cavity packing. Moreover, we aimed to conduct a Trial Sequential Analysis to evaluate the robustness of the findings

Methods

Study design

This systematic review protocol was designed and conducted according to the recommendations of the Cochrane Handbook for Systematic Reviews of Interventions [15] and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines for reporting meta-analyses [16].

All randomised controlled trials investigating outcomes of incision and drainage of cutaneous abscesses with and without abscess cavity packing were identified. Patients of any age and gender with a diagnosed cutaneous abscess in any part of the body were considered for inclusion. The intervention of interest was incision and drainage of abscess with the packing of the abscess cavity using any type of dressing. The intervention of interest was compared with incision and drainage of abscess without post-operative packing.

Outcomes

The primary outcome measure was abscess recurrence at maximum follow-up period, while the development of fistula in-ano and need for a second intervention during the first 48 h post-operatively were considered as secondary outcome measures.

Literature search

A comprehensive search strategy was developed and searched through PubMed, MEDLINE, EMBASE, Cochrane Central Register of Controlled Trials (CENTRAL) and CINAHL Plus. Our search strategy and choice of electronic data sources were in line with recommendations provided for optimal literature search for systematic reviews in surgery [17]. The literature search strategy is shown in Appendix Table 3. The reference lists of the identified studies were evaluated to identify potential, more relevant studies. The searches were limited to human subjects and had no language or publication date restrictions. The final search was carried out on 03 June 2020. Two authors executed the literature search independently, removed the duplicate records, assessed the titles and abstracts for relevance, and tagged the articles as included or excluded. Disagreements in the selection of studies were resolved by discussion between the review authors. However, if the discrepancies remained unresolved, a third review author was consulted.

Data collection

The following information was extracted from the included studies: first author, year of publication, the country in which the study was conducted, study design, study size, and description of the study participants including the number of patients, patient characteristics, and outcome measures. Extracted data were entered into a pre-generated standard Microsoft® Excel (Microsoft Corporation, Redmond, Washington, USA) file. Data extraction was performed independently by two authors, and disagreements were resolved by discussion and consensus. If no agreement could be reached, a third author was consulted**.**

Data synthesis and statistical analyses

The risk ratio (RR) with 95% confidence intervals (CI) was estimated for all evaluated outcomes. The RR is the risk of an adverse event in the group with no abscess cavity packing compared to the packing group. A RR of less than one would favour the former.

The results were considered statistically significant at the P value of less than 0.05 levels and if the 95% CI did not include 1.00. Random-effects modelling was applied as for analyses. The Cochran Q test ($\chi 2$) was used to evaluate heterogeneity and I^2 was reported to quantify it; a value of 0% indicated no heterogeneity and over 50% indicated significant heterogeneity. We planned to create a funnel plot to evaluate the presence of publication bias for outcomes reported by at least ten studies [18]. All statistical analyses were conducted using RevMan 5.3 [19].

We performed subgroup analysis for abscess recurrence with respect to paediatric patients, adult patients, use of antibiotics, and anorectal abscess.

We conducted sensitivity analyses to explore potential sources of heterogeneity and assess the robustness of our results. For each of our defined dichotomous variables, we calculated the pooled odds ratio (OR) or risk difference (RD). Finally, we evaluated the effect of each study on the overall effect size and heterogeneity by repeating the analysis following the exclusion of one study at a time (one-leave out sensitivity analyses).

Assessment for risk of bias

Risk of bias was assessed, independently, by two authors using the Cochrane risk of bias tool [20]. The following categories were classified as high, low, or unclear: random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, selective reporting, and other sources of bias. Variations in the risk of bias assessment were solved by a discussion between authors.

Trial sequential analysis

Trial sequential analysis was performed for the outcomes reported by at least 5 trials using the trial sequential analysis software 0.9.5.5 Beta (Copenhagen Trial Unit, Copenhagen, Denmark) (Fig. 3). The thresholds for the Z values using O'Brien-Fleming α-spending function were adjusted to control the risk of type 1 error. The Z values were penalised according to the strength of the available evidence and the number of repeated significance tests as defined by the law of the iterated logarithm. The risk of type 2 error was controlled using the β-spending function and futility boundaries. Random effects modelling were applied. A two-sided CI with 95% confidence level was used to indicate statistical significance. We estimated the information size for the analyses based on the achievement of 80% power and 10% relative risk reduction between the two groups.

Results

Our comprehensive literature search identified a total of eight eligible RCTs [21–28] for inclusion (Fig. 1). The included studies reported a total of 485 patients who underwent incision and drainage of abscess without packing (n = 242) or with packing (n = 243).

The basic characteristics of the included studies are presented in Table 1. Three studies exclusively included anorectal abscess patients [21, 25, 26], while the remaining five studies included various types of cutaneous abscesses. Regarding use of antibiotics, oral antibiotics were used routinely in four studies [22, 24, 27, 28] and selectively in one study [23], while in the remaining studies use of antibiotics was unclear.

Baseline characteristics of the packing versus non-packing groups were comparable in terms of age, gender, duration of symptoms, and size of the abscess (Table 2).

Assessment of risk of bias

Seven of the included RCTs [21–23, 25–28] reported random sequence generation, while allocation concealment was reported in four studies [22, 23, 26, 28]. No study reported blinding of participant and personnel, whereas blinding of outcome assessor was attempted in three studies [22, 23, 28]. The risk of detection and performance bias remains unclear or high in the rest of the studies. Four studies were considered to have a high risk of attrition bias [21, 23, 24, 26], while all studies were classified as low risk of bias

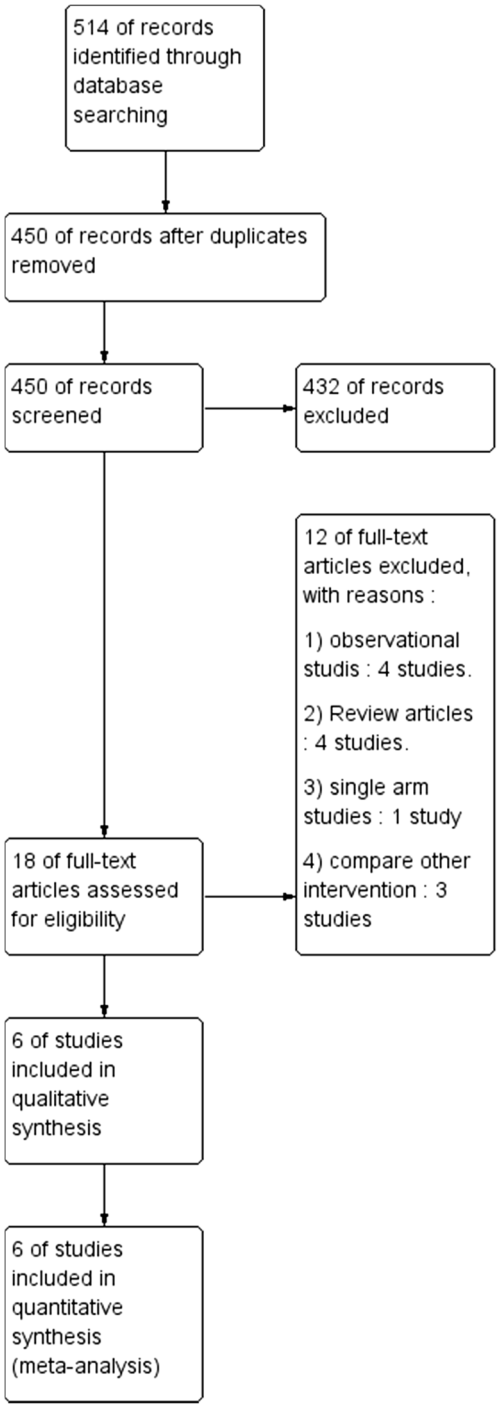


Fig. 1 PRISMA flow chart

Table 1 Characteristics of included randomized controlled trials (RCTs). *NPG*, non-packing group; *PG*, packing group; *USA*, United States of America; *UK* United Kingdom

First Author	Year	Country of origin	Type of the study	Total number of population	Distribution of population	Type of abscess	Antibiotics
Tonkin [21]	2004	Australia	RCT Randomization: sealed envelope system.	43	NPG 23 PG 20	Anorectal	NA
O'Malley [22]	2009	USA	RCT Randomization : computer randomization scheme	48	NPG 25 PG 23	Various types	Oral antibiotics
Kessler [23]	2012	USA	RCT Randomization: sealed envelope system.	49	NPG 22 PG 27	Various types	Given to selected cases
Leinwand [24]	2013	USA	RCT Randomization: Unclear.	85	NPG 42 PG 43	Various types	Oral antibiotics
Perera [25]	2014	UK	Pilot RCT Randomization: sealed envelope system.	14	NPG 6 PG 8	Anorectal	No antibiotics
Islam [26]	2016	Bangladesh	RCT Randomization: sealed envelope system.	50	NPG 26 PG 24	Anorectal	NA
Rijal [27]	2017	Nepal	RCT Randomization: even and odd numbering.	92	NPG 46 PG 46	Various types	Oral antibiotic
Kumar [28]	2018	Nepal	RCT Randomization: computer-generated randomized list and sealed envelope system.	104	NPG 52 PG 52	Various types	Oral antibiotic

regarding selective reporting. An overview of the risk of bias is shown in (Fig. 2).

Primary outcomes

Recurrence of abscess at maximum follow-up period

Recurrence of the abscess was reported in 6 RCTs, including a total of 289 patients (Fig. 3). The overall risk of recurrence of the abscess was 5.9%. There was no significant difference in the risk of recurrence between two groups (6.9% vs 4.8%, RR 1.31, 95% CI 0.53–3.24, $P = 0.56$). The level of heterogeneity was low amongst the included studies ($I^2 = 0\%$, $P = 0.75$).

Secondary outcomes

Development of fistula-in-ano

This outcome was reported in 3 RCTs, including a total of 107 patients (Fig. 3). The overall risk of fistula-in-ano formation following incision and drainage of ano-rectal abscess was reported as 16.8%. There was no statistically significant difference in this risk of formation of fistula-in-ano between the two groups. (12.7% vs 21.1%, RR 0.61, 95% CI 0.27, 1.45, $P = 0.28$). There was a low level of heterogeneity amongst the included studies ($I^2 = 0\%$, $P = 0.81$).

Second intervention during 48-h post-operative

Out of the eight studies, the need for secondary intervention during the first 48 h was reported in 4 RCTs, including 293 patients in total (Fig. 3).There was no significant difference in the need for a second intervention between the packing and – non-packing groups (33.7% vs 52%, RR O.70, 95% CI 0.49–0.99, $P = 0.05$). A low level of heterogeneity exists amongst the included studies ($I^2 = 38\%$, $P = 0.19$).

Other outcomes

Post-operative pain was reported in five studies; however, we were not able to analyse the data using meta-analytical model due to heterogeneous reporting of the outcome with respect to the time of pain score assessment, the scale of pain score, and the way that the included studies reported their continuous outcomes. Four studies [22, 24, 26, 29] did not find any significant difference in post-operative pain between incision and drainage of abscess with or without packing. One study [23] reported significantly lower post-operative pain in favour of incision and drainage without packing when compared with the packing of the abscess cavity. Furthermore, we were not able to analyse healing time as an independent outcome due to the nature of the reported data. Two studies [26, 27] reported significantly lower healing time in favour of non-packing, while one study [22] reported no significant difference in the healing time between the two groups.

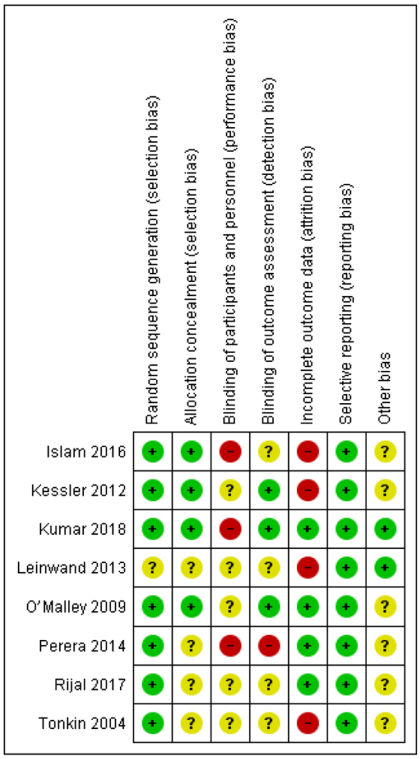
Subgroup analysis

Anorectal abscess Sub-group analysis for studies that included only anorectal abscess included 107 patients and demonstrated no significant difference between the two groups regarding recurrence of the abscess (12.7% vs 11.5% , RR 1.13 , 95% CI 0.41–3.12, $P = 0.81$).

Table 2 Baselines characteristics of RCTs population. *NPG*, non-packing group; *PG*, packing group; *SD*, standard deviation; *IQR*, interquartile range; *NA*, not available; *cm*, centimetre

Study	Age (years) Median (range/IQR)	Male:female	Size of abscess (cm) median (range/IQR)	Duration of symptoms (days) Median (range/IQR)	Type of population	Inclusion and exclusion criteria
Tonkin 2004 [21]	NPG: 33 (19–65) PG: 32.5 (21–58)	NPG 18:5 PG 17:3	NPG 3.0 PG 3.0	NPG 3 PG 4	Adults	Inclusion criteria: patients > 18 years of age with anorectal abscesses. Exclusion criteria: abscesses associated with Crohn's disease or other underlying causes, inadequate drainage of the abscess, and patients unable to give informed consent.
O'Malley 2009 [22]	NPG (mean ± SD): 30.48 (± 14.82) PG (mean ± SD): 29.70 (± 11.26)	NPG 13:12 PG: 12:11	NA	NA	Adults	Inclusion criteria: patient's ≥ 18 years of age with cutaneous abscesses located on the trunk or extremities. Exclusion criteria: abscesses larger than 5 cm in any dimension; pregnancy , diabetes, HIV, malignancy, chronic steroid use; immunosuppressive states , abscesses located on the face, neck, scalp, hands, feet, perianal, rectal, or genital areas; hidradenitis or pilonidal abscesses; allergy to sulfa or hypersensitivity to trimethoprim- sulfamethoxazole (TMP-SMX); need for procedural sedation or supplemental treatment (intravenous antibiotics or surgical consultation) based on physician's discretion; or subject inability to return for 48-h follow-up.
Kessler 2012 [23]	NPG: 17 (6) PG: 18 (6)	NPG 15:7 PG: 18:9	NPG 4.2 (6) PG 3.6 (8)	NPG 5 (4) PG 5 (3)	Paediatrics	Inclusion criteria: Ages 1–25 years with superficial skin or soft tissue abscess needing incision and drainage. Exclusion criteria: Immunocompromised patients, had recurrence of a prior abscess, spontaneously draining abscess, required a subspecialist for drainage, or if the lesion was less than 1 cm or located on the face, genitals, or perianal area.
Leinwand 2013 [24]	NA	NA	NPG 4.6 (2–15) PG 5.7 (1.5–17)	NA	Paediatrics	Exclusion criteria: diabetic, immunosuppressed, perianal abscess, pilonidal abscess, and abscess secondary to a previous operation.
Perera 2014 [25]	NPG: 48.00 (7.00) PG: 47.00 (17.00)	NPG 2:4 PG 5:3	NA	NPG 6.00 (11.75) PG 4.00 (4.00)	Adults	Inclusion criteria: patients > 18 years of age with perianal abscess. Exclusion criteria: patients under the age of 18 years, patients unable or unwilling to give consent, recurrent abscess due to inadequate drainage. Abscesses associated with known fistulae, Crohn's disease, immunosuppression, malignancy or other underlying causes were excluded.
Islam 2016 [26]	NPG: 36.5 (20–65) PG: 37.5 (21–65)	NPG 20:6 PG 19:5	NPG 2.5 (2.0–3.5) PG 2.5 (2.5–3.5)	NPG 3 PG 2	Adults	Inclusion criteria: patients ≥ 20 years of age with anorectal abscess. Exclusion criteria: patients under the age of 20 years, patients unable or unwilling to give consent, recurrent abscess due to inadequate drainage. abscesses associated with known fistulae, Crohn's disease, immunosuppression, malignancy or other underlying causes were excluded
Rijal 2017 [27]	33	NA	NA	NA	Adults	Inclusion criteria: 18 years and older with a single abscess in the trunk, extremities and breast. Exclusion criteria: abscess larger than 7 cm in widest dimension, patients with comorbid conditions including diabetes and HIV, immuno-suppressive states, steroid use, malignancy, undergoing CT and RT. Patients with perianal abscess, head neck and face abscess, chest wall abscess with extension into the thoracic cavity and abdominal abscess with intra-abdominal extension were excluded
Kumar 2018 [28]	NPG 25.35 ± 18.24 PG 26.29 ± 17.66	NPG 31:21 PG 22:30	NA	NPG 8.19 ± 6.42 PG 10.04 ± 7.73	Adults and paediatrics	Inclusion criteria: individuals with age ≥ 1 year, of either sex, with skin and soft tissue abscess were included in the study. Exclusion criteria: age < 1 year, pregnant, post-operative abscess., immunocompromised, multiple abscesses requiring drainage, recurrence of the same abscess, Bartholin's abscess, facial abscess, neck abscess, abscess in intermuscular plane, and not giving consent.

a) Risk of bias summary of included RCTs



b) Risk of bias graph of included RCTs.

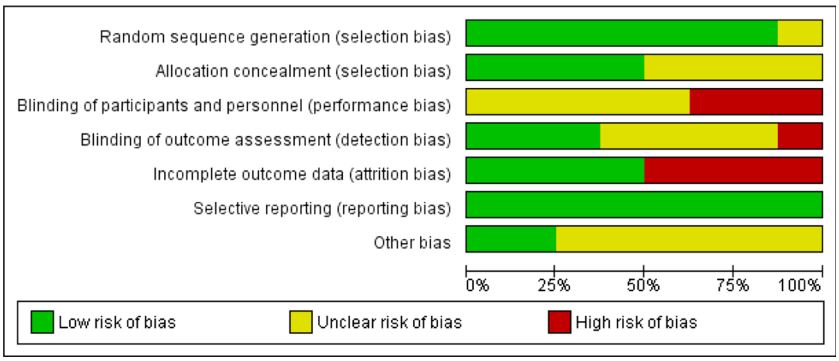


Fig. 2 Risk of bias assessment of included RCTs. **a** Risk of bias summary of included RCTs. **b** Risk of bias graph of included RCTs

Paediatric patients Sub-group analysis for studies that exclusively included paediatric population included 134 patients and revealed no significant difference in the risk of abscess recurrence between the non-packing and packing groups (4.7% vs 1.4%, RR 2.31, 95% CI 0.31–17.40, $P = 0.42$).

Adult patients Sub-group analysis for studies that exclusively included adult population included 155 patients and revealed no significant difference in the risk of abscess recurrence between the non-packing and packing groups (8.7% vs 8.0%, RR 1.13 , 95% CI 0.41–3.12, $P = 0.81$).

Antibiotic use Subgroup analysis for studies that used antibiotics included 182 patients and revealed comparable rate of recurrence between the two groups (3.4% vs 1.1%, RR 2.31, 95% CI 0.31–17.40, $P = 0.42$)

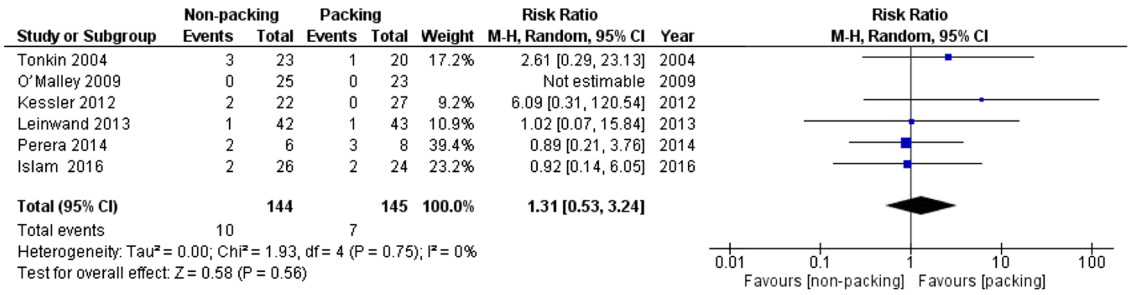
Sensitivity analysis

The direction of the pooled effect size remained unchanged when OR or RD was calculated for dichotomous variables. Furthermore, leave one out analysis has not demonstrated important discrepancies with original analysis

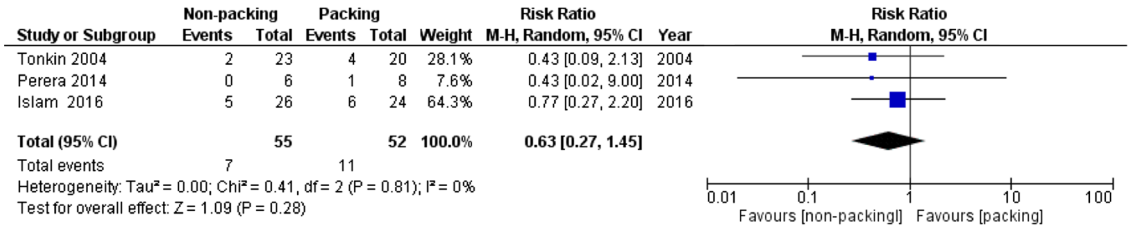
Trial sequential analysis

Recurrence The information size was calculated at 1036 patients. The *Z* curve did not cross the conventional boundaries,

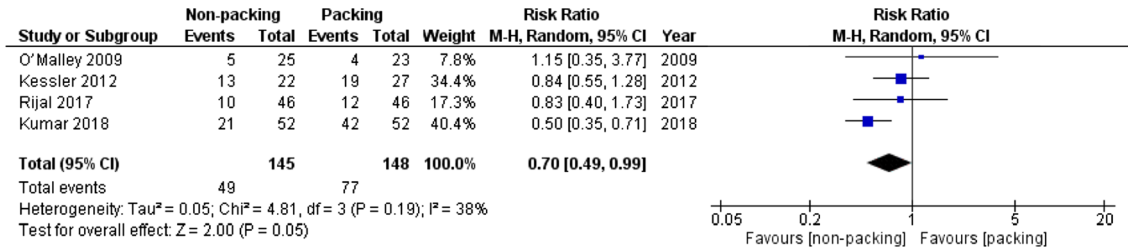
a) Recurrence of abscess.



b) Development of Fistula in-ano.



c) Second intervention during 48 hours post-operative.



d) Figure 3 : Forest plots of the measured outcomes ; a) Recurrence of abscess. b) Development of Fistula in-ano. c) Second intervention during 48 hours post-operative.

Fig. 3 Forest plots of the measured outcomes. **a** Recurrence of abscess. **b** Development of Fistula in-ano. **c** Second intervention during 48-h post-operative

and the absolute number for penalised *Z* value remained smaller than 1.96 in both sides before the information size was reached. However, the *Z* curve did not cross the futility boundaries before the information size is reached; therefore, the meta-analysis was not conclusive, and the results for recurrence were subject to type 2 error (Fig. 4).

Discussion

Incision and drainage of a cutaneous abscess with the packing of the abscess cavity have been the standard management for many years. However, the beneficial role of the use of packing has been questioned by some studies making a choice between packing and non-packing controversial. In view of the existence of such controversy, we conducted a comprehensive systematic review and meta-analysis of 8 RCTs reporting a total of 485 patients of whom 242 underwent incision and drainage of abscess without packing, and the remaining 243 patients had the procedure with the packing of the abscess cavity. The meta-analysis of reported outcomes demonstrated that there was no significant difference in recurrence, the formation of fistula-in-ano, or need for a re-intervention within 48 h between two groups. However, we conducted a Trial Sequential Analysis to assess the robustness of our findings which demonstrated that the meta-analysis is not conclusive, and the findings are subject to type 2 error.

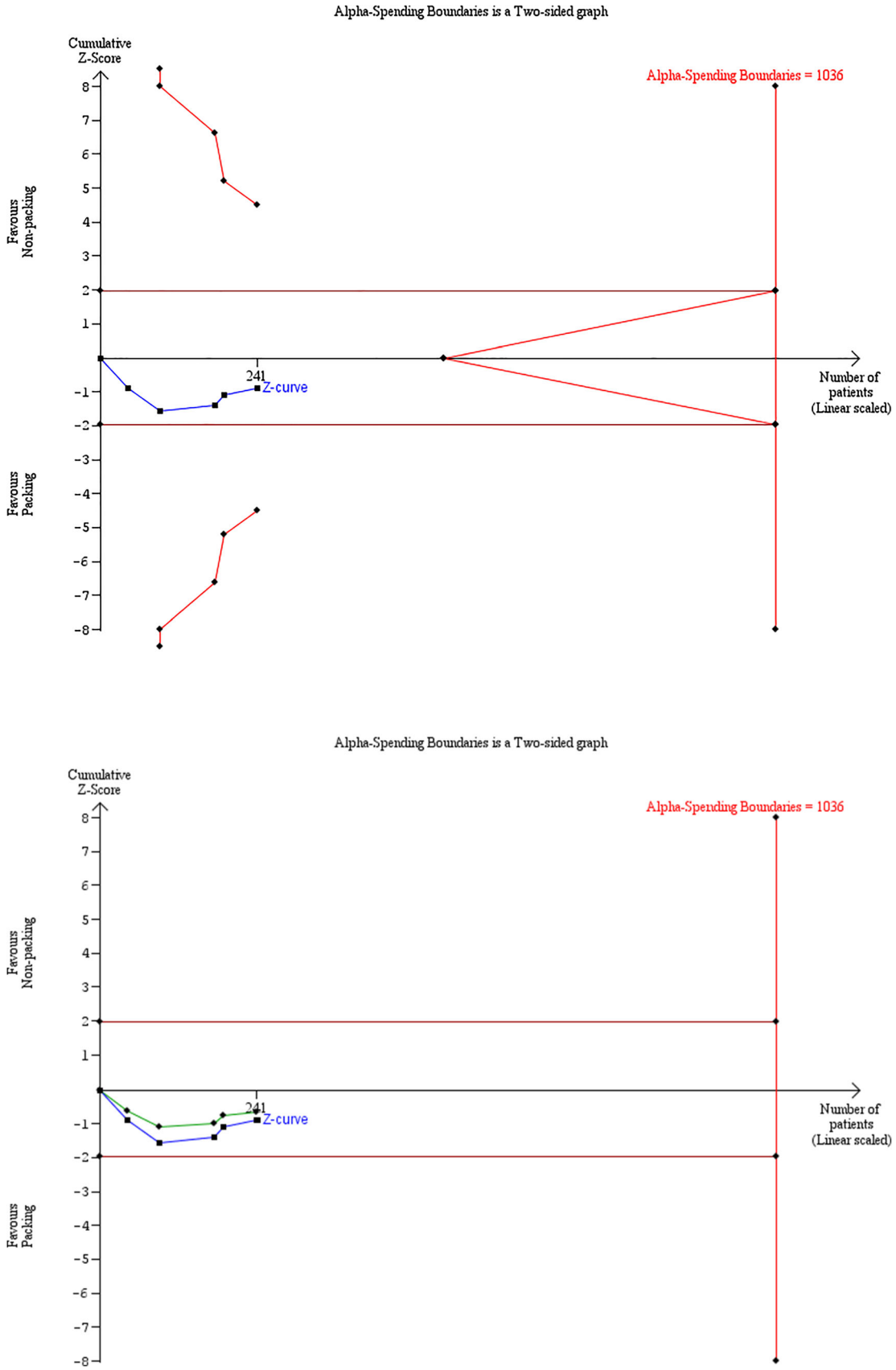


Fig. 4 Results of trial sequential analysis for recurrence

Packing of the abscess cavity has been believed to reduce the risk of recurrence by preventing premature closure of the cavity [10]. Considering the increasing incidence of cutaneous abscesses over the last decade [29] and the need for frequent input from the community to change the abscess cavity packing, there has been a substantial increase in financial costs and use of valuable healthcare resources [30]. Our findings suggest that there seems to be no difference in recurrence of a cutaneous abscess between incision and drainage of cutaneous abscess with and without packing of the cavity. This is an important finding which can potentially lead to the more efficient expenditure of the available resources and reduction in workload in different settings. We have conducted sub-group analyses for adults and paediatric patients, anorectal abscesses, and the use of perioperative antibiotics which demonstrated that the risk of recurrence remained comparable between two groups. In the present meta-analysis, the overall risk of recurrence of abscess following incision and drainage was 5.9%. However, in the literature, the risk of recurrence varies between 3 and 44%. It has to be taken into account that our included studies are probably under-powered and have very small sample sizes which not only subject our findings to type 2 error but also may explain the low pooled rate of recurrence. The risk of recurrence after incision and drainage of a cutaneous abscess is partly dependent on anatomical location. Other risk factors for recurrence include inadequate initial drainage, obesity, and smoking status [6, 31–34].

The use of antibiotics such as trimethoprim, sulfamethoxazole, and clindamycin following drainage of an abscess has been suggested in order to reduce the risk of recurrence. However, antibiotic resistance and side effects are considered major drawbacks in this approach [35–37]. Although the use of pre-operative or post-operative antibiotics was heterogeneously reported by the included studies, our sub-group analysis with respect to the use of antibiotics did not demonstrate any difference in recurrence rate between two groups. Nevertheless, no definitive conclusions can be drawn as the use of antibiotics, the type of antibiotics used, the duration of antibiotic therapy, and proportion of patients receiving antibiotics varied among those studies that reported the use of antibiotics. Moreover, most importantly, the studies that reported the use of antibiotics in their patients did not report the outcomes with respect to the use of antibiotics.

Only three of our included studies reported the outcomes of incision and drainage of anorectal abscesses with or without packing. The American Society of Colon and Rectal Surgeons (ASCR) advocate using an adequately sized elliptical incision to drain an abscess so that packing, and its associated complications, may be avoided [38]. Furthermore, guidelines produced by German Society of General and Visceral Surgery (DGAV), the Surgical Working Group for Coloproctology (CACP), the German Society of Coloproctology (DGK), and the Association of Coloproctologists in Germany (BCD), evaluating wound care and post-operative management of drained peri-anal abscesses have concluded that packing of the abscess cavity and using local antiseptic solutions are unnecessary [39]. Our findings of sub-group analysis for anorectal abscess are in agreement with the aforementioned recommendations. In fact, we did not find any difference in recurrence of anorectal abscess between the packing and non-packing groups.

The reported incidence of fistula formation post incision and drainage of anorectal abscesses can be as high as 37% [40]. This relatively high rate suggests that the two conditions are different manifestations of the same underlying pathology. A Cochrane review in 2010 concluded that treating a fistula in-ano simultaneously at the time of incision and drainage of an abscess reduces the subsequent risk of abscess recurrence and further surgical intervention [41]. However, this practice is often avoided due to fears of creating false passages and anal sphincter damage. In our analysis, we found no significant difference in post-operative fistula formation between packing and non-packing groups.

We were not able to evaluate the post-operative pain as one of the most important post-operative outcomes due to heterogeneous reporting by the included studies. Incision and drainage of a cutaneous abscess have been rated as the second most painful procedure performed in the accident and emergency department [42]. Therefore, a procedure that most avoids pain is preferable. Trials investigating pain and pain management post abscess drainage are scanty. The procedure of changing packs on a regular basis can be painful and distressing for all and especially in the paediatric population [15]. The future studies are strongly encouraged to homogenously report post-operative pain as an important outcome.

The incidence of cutaneous abscess formation is probably underestimated worldwide, and the actual number of patients suffering from the condition is thought to be much higher. In the USA, an estimated incidence of 4% of the population affected by abscess formation has been reported [43]. In Western Europe, an estimated 0.5–0.6% of the population seeks medical treatment for cutaneous abscesses annually in, for example, Belgium and the Netherlands [44, 45]. The total costs to the healthcare system can be significant, given that a minimum of five visits to a general practitioner or practice may be required for post-procedure care. One study has estimated the annual cost in the UK of £1.4–£2.5 million for changing packs alone following drainage of peri-anal abscesses [31]. Therefore, demonstration of comparable outcomes of incision and drainage of a cutaneous abscess with or without packing will avoid such high cost. Nevertheless, we did not conduct an analysis of cost-effectiveness in this meta-analysis.

Our meta-analysis demonstrated that the best available evidence, albeit coming from RCTs, is associated with several limitations. Interestingly, despite being a very prevalent surgical presenting complaint, the number of patients with

cutaneous abscesses is very small in most of the included studies. Moreover, the reported outcomes by the included studies, except for recurrence, have been heterogeneous. We are looking forward to the first report of two ongoing better quality RCTs; PPACK2 study (ClinicalTrials.gov Identifier: NCT03315169) and University of California study (ClinicalTrials.gov Identifier: NCT02822768), which may provide stronger evidence in favour of either packing or non-packing.

Together with the limitation of the available studies, our meta-analysis has its own limitations that need to be considered when interpreting our findings. Our findings are subject to type 2 error due to the aforementioned reasons. The efficacy of packing might have been variable among the included studies. If packing was not performed well or combined with variable timing, variable agents and variable irrigation regimes, the outcomes of that would have been negatively affected, disadvantaging the packing group. In all studies, particularly the paediatric studies, inefficiencies, or abandonment of the packing regime might have affected results by equalising the outcomes of both packing and non-packing.

Conclusion

This systematic review and meta-analysis of the best available evidence demonstrated that incision and drainage of cutaneous abscess with or without packing have comparable outcomes. However, the available evidence, which is based on inadequately powered RCTs, is subject to type 2 error and no definitive conclusions can be made. The findings of the better quality ongoing RCTs may provide stronger evidence in favour of packing or non-packing.

Authors' contribution Conception and design: AYYM, SZ, SH; Literature search and study selection: AYYM, SZ; Data collection: AYYM, SZ, UD; Analysis and interpretation: AYYM, SS, SH; Writing the article: All authors; Critical revision of the article: All authors; Final approval of the article: All authors; Statistical analysis: AYYM, SZ.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval Considering the nature of this study, ethical approval was not required.

Human and animal rights This study is a systematic review with meta-analysis of outcomes which does not include research directly involving human or animal participation.

Informed consent Considering the nature of this study, informed consent was not required.

Appendix

Table 3 Note: This data is mandatory. Please provide.

Search No	Search strategy*
#1	MeSH descriptor: [pack] explode all trees
#2	Packing: TI, AB, KW
#3	MeSH descriptor: [incision and drainage] explode all trees
#4	Incision and drainage: TI, AB, KW
#5	#1 OR #2 OR #3 OR #4
#6	MeSH descriptor: [abscess] explode all trees
#7	Abscess: TI, AB, KW
#8	Cutaneous abscess: TI, AB, KW
#9	Abscess cavity: TI, AB, KW
#10	#6 OR #7 OR #8 OR #9
#11	#5 AND #10

*This search strategy was adopted for following databases: MEDLINE, EMBASE, CINAHL and the Cochrane Central Register of Controlled Trials (CENTRAL)

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