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Effectiveness of silver and iodine dressings on wound healing: a systematic review and meta-analysis

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ABSTRACT

Objective To evaluate the effects of silver and iodine dressings on healing time, healing rate, exudate amount, pain and anti-infective efficacy.

Design Systematic review and meta-analysis.

Data sources Databases including PubMed, Cochrane Library, Embase, Web of Science and CINAHL were surveyed up to May 2024.

Eligibility criteria Randomised controlled trials comparing silver and iodine dressings on wound healing in humans.

Data extraction and synthesis Evidence certainty was evaluated using the Grading of Recommendations, Assessment, Development, and Evaluation approach. Data extraction was done independently by two reviewers, with the risk of bias assessed using the Cochrane tool. Narrative synthesis was performed to evaluate the effects of silver and iodine dressings on healing time, healing rate, pain, exudate amount and anti-infective efficacy. Meta-analysis using Review Manager V.5.4 calculated standardised mean differences for healing time and relative risks for rate to quantify the impacts of the treatments.

Results 17 studies (18 articles) were included. The meta-analysis indicated that silver dressings significantly reduced healing time compared with iodine dressings (SMD=-0.95, 95% CI −1.62 to −0.28, I^2=92%, p=0.005, moderate-quality evidence), with no significant difference in enhancing healing rate (RR=1.29, 95% CI 0.90 to 1.85, I^2=91%, p=0.16, low-quality evidence). Based on low-quality evidence, for exudate amount (3/17), 66.7% (2/3) of the studies favoured silver dressings over iodine in reducing exudate volume. For pain (7/17), 57.1% (4/7) of the studies reported no significant difference between silver and iodine dressings, while 42.9% (3/7) studies indicated superior pain relief with silver dressings. For anti-infective efficacy (11/13), 54.5% (6/11) of the studies showed equivalence between silver and iodine dressings, while 36.4% (4/11) suggested greater antibacterial efficacy for silver.

Conclusion Silver dressings, demonstrating a comparable healing rate to iodine dressings, significantly reduce healing time, suggesting their potential as a superior adjunct in wound care.

PROSPERO registration number CRD42020199602.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ The strength of the systematic review lies in its rigorous methodology, adhering to Cochrane and Preferred Reporting Items for Systematic Reviews and Meta-Analysis guidelines, ensuring a high standard of scientific integrity and replicability.
⇒ The search inclusivity of non-English literature, guided by rigorous strategies, showcases a pioneering commitment to global comprehensiveness, likely enriching the evidence base with diverse perspectives.
⇒ Independent use of the Cochrane risk-of-bias tool and Grading of Recommendations, Assessment, Development, and Evaluation for evidence certainty, coupled with a dual extraction process, reflects an innovative dedication to methodological rigour and data integrity.
⇒ Despite the methodological rigour, the acknowledged heterogeneity across studies might limit the generalisability of findings, suggesting a need for innovative approaches to synthesise diverse data effectively.

INTRODUCTION

The wound is one of the most common clinical problems. Wounds that continue to occur in all health settings place a financial burden on healthcare systems while increasing patient stress and reducing the quality of life.[1–3] Wound dressings play an important role in wound management, including protecting the surrounding healthy skin, supporting autolytic debridement, absorbing exudate, accelerating the rate of epithelialisation and lowering microorganism density.[4] Numerous options for wound dressings are commercially available, varying according to dressing material (eg, film, hydrocolloid, hydrogel and foam) or antimicrobial agents (eg, silver and iodine).[5–7] Among them, silver and iodine dressings are more common in the clinical practice of wound care due to their ease of use, low cost and ability to deal with excess exudates, prevent bacteria from entering and promote wound healing.[8–11]

Both silver and iodine dressings can effectively promote wound healing. According to checklists for wound healing assessments,[12 13]

the effectiveness of wound healing is usually assessed by healing time, healing rate, exudate amount, pain or anti-infective efficacy.[14] Iodine dressing has been established as an effective agent with a broad antimicrobial spectrum, low microbial resistance, low cytotoxicity and good tolerability.[15] Compared with hydrocellular foam dressing and petrolatum gauze, iodine dressing required less time to complete epithelialisation (p=0.0003, p=0.0205).[16] Silver dressing is recognised as a safe and effective topical antimicrobial agent that is highly cost-effective[17] and can be used against a broad spectrum of common wound pathogens.[18] A meta-analysis of eight randomised controlled trials (RCTs) showed that compared with other dressings (eg, brine dressing, activated carbon cloth, sterile polyacrylate wound pad, alginate dressing and hydropolymer adhesive dressing), silver dressings significantly increased the rate of healing,[19] reduced pain-related symptoms and decreased wound exudates (p<0.001).[20] However, this meta-analysis did not include studies comparing iodine and silver dressings for wound treatment.

There is an urgent need for rigorous and empirical research to evaluate the effectiveness of silver/iodine dressings in wound management. There are a few RCTs comparing the wound-healing effects of two dressings, but the results are controversial. For instance, Singh and Apte[21] found that compared with povidone dressing, silver foam significantly shortened the wound healing time (p=0.0058), which is in contrast to that of Homann *et al*.[22] We systematically searched PubMed, Cochrane Library, Embase, Web of Science and CINAHL databases using key terms such as 'wounds', 'silver' and 'iodine' to ensure comprehensive coverage of relevant research areas. Additionally, we checked the PROSPERO database, an international registry for systematic reviews. Then we confirm that no ongoing or published systematic reviews on comparative studies of silver and iodine dressings have been registered so far. Therefore, the aim of this study was to compare and analyse the effects of iodine and silver dressings on wound healing and provide an evidence-based basis for the clinical practice of wound management.

METHODS

This systematic review and meta-analysis was performed according to the Cochrane Handbook for Systematic Reviews of Interventions[23] and reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis guidelines.[24] The protocol for this systematic review and meta-analysis was registered with PROSPERO (CRD42020199602).

Eligibility criteria

Inclusion criteria were as follows: (1) participants were humans with wounds, and no further restrictions were placed on basic information such as the age and gender of the patients or the type of wound; (2) the study included articles in both English and non-English languages that reported RCTs comparing the effects of silver and iodine dressings on wound treatment; (3) studies included, but were not limited to, the following outcome measures: healing time, healing rate, exudate amount, pain management and anti-infective efficacy. Exclusion criteria were as follows: (1) single-arm clinical trials, case series, reports, conference abstracts or comments on other studies and (2) studies with unknown target outcomes of interest.

Search strategy

We executed a thorough search across PubMed, Cochrane Library, Embase, Web of Science and CINAHL via the Central South University Library, capturing records from their inception to the present. Further access to the library's resources can be obtained through the Central South University Library (https://lib.csu.edu.cn/).

Employing MeSH terms and free-text keywords, enhanced by Boolean operators, our search encompassed topics such as 'Wounds and Injuries', 'Wound Infection', 'Wound Healing', 'Surgical Wound Infection', 'Surgical Wound Dehiscence', 'Surgical Wound', 'stab wounds', 'penetrating wounds', 'gunshot wounds' and 'Multiple Trauma', alongside broader terms 'wound*', 'injur*', 'trauma*', 'silver*' and 'iodin*'. The use of wildcard (*) increased search sensitivity by capturing various word forms and derivatives.[25] Full-text searches were performed where possible, with the exception of Web of Science. Furthermore, to encompass grey literature and unpublished research, we used subject-specific terminology and free-text keywords on the Data Archiving and Networked Services platform (https://easy.dans.knaw.nl/ui/datasets/id/easy-dataset:200362/tab/2) and the ProQuest Dissertations & Theses database (https://about.proquest.com/en/dissertations/). This comprehensive approach was initiated in December 2018 and updated in May 2024. The complete search strategy is provided in the online supplemental material 1.

Study selection

The results of the systematic searches were imported into the EndNote V.20 (Clarivate Analytics, Pennsylvania, USA) reference manager and duplicate references were removed using both the software and manual checks. Two investigators (YJ and WD) independently screened the titles and abstracts based on the inclusion and exclusion criteria. Where there were disagreements, full-text articles were then downloaded for eligibility assessment. Where necessary, a third investigator (JG) intervened to resolve disputes. A consensus was reached for all included studies.

Quality assessment

Two investigators (YJ and WD) independently assessed each included study using the Cochrane tool to assess the risk of bias.[26] This tool addresses six specific domains: sequence generation, allocation concealment, blinding, incomplete outcome data, selective outcome reporting and other biases. Similarly, investigators assessed the

certainty of the evidence independently and in duplicate, using the Grading of Recommendations, Assessment, Development, and Evaluation (GRADE) approach. The certainty of the evidence ranges from very low to high. The RCTs were initially considered high-quality evidence and were downgraded based on prespecified criteria. It depends on risk of bias, inconsistency, indirectness, imprecision and other considerations such as publication bias. Risk of bias, assessed with the Cochrane tool, led to a downgrade if high-risk studies were judged to influence the pooled effects. Inconsistency, evaluated with I^2 estimates, resulted in a downgrade when I^2 was 60% or higher, indicating substantial heterogeneity. Indirectness was downgraded when factors related to participants, interventions or outcomes affected the generalisability of the findings. Imprecision was downgraded if the 95% CI included half or less of the minimal important difference for continuous outcomes, or included a relative risk RR of 1 for dichotomous outcomes, or when the study included fewer than 400 participants, indicating an insufficient sample size. Publication bias, indicated by funnel plot asymmetry, led to a downgrade in evidence certainty due to potential selective reporting or missing studies. Disagreements were resolved by consensus or by consulting a third investigator. A summary of findings was created using the GRADEpro Guideline Development Tool (https://www.gradepro.org/).

Data extraction

The study data were compiled and entered into a purpose-built database using a framework adapted from the data collection checklist of Effective Practice & Organization of Care.[25] It provides helpful guidance for reviewers on the types of relevant information extracted from primary studies.[27] Author details, year of publication, country and sample size were extracted as characteristics of each study; the information was combined to synthesise the findings. The type of dressing was extracted as characteristics of the intervention. The effectiveness of iodine versus silver dressings was assessed for healing time, healing rate, reduction in exudate amount, pain and anti-infective efficacy. If the results of a single study were reported in more than one publication, the data from these publications were combined into one study entry. Again, two reviewers (YJ and WD) independently extracted the primary data and resolved discrepancies through mutual consensus or by consulting a third reviewer (JG). The data extraction process was critically appraised to ensure the accuracy and relevance of the extracted data.

Statistical analysis

Data were analysed using Review Manager V.5.4 software. All data were double entered into the database to minimise errors. Acknowledging the methodological heterogeneity in outcome assessment across studies, we selected a random effects model to accommodate variability. For dichotomous data, we calculated the RR, with an RR>1 suggesting superior healing rate with silver dressings. For continuous outcomes, we used the standardised mean difference, which is deemed significant when the 95% CI does not encompass zero, indicating a non-chance effect of the intervention. Heterogeneity was methodically assessed with the χ^2 test and I^2 statistic, where an I^2>50% signals substantial variability. Considering the variability in clinical and methodological approaches among the studies included, we established a priori criteria for conducting a meta-analysis. We determined that a minimum of three studies was required to ensure the statistical robustness and clinical interpretability of the pooled effect sizes.[28] Studies that reported outcomes not amenable to standardisation or lacked adequate data for effect size calculation were consequently excluded from the meta-analysis. The asymmetry of the funnel plot was assessed for the presence of publication bias.

Patient and public involvement

Patients and/or the public were not involved in the design, conduct, reporting or dissemination plans of this research.

RESULTS

Study inclusion

The database search yielded 2450 studies, with an additional 1005 records obtained from the Data Archiving and Networked Services platform and the ProQuest Dissertations & Theses database. After removing duplicates and screening at the title and abstract level, a total of 47 full-text articles were reviewed for eligibility. On thorough examination of the full texts, 29 articles were excluded. The online supplemental material 2 contains a list of excluded studies along with the reasons for their exclusion. Ultimately, 18 articles met the inclusion criteria, of which 2 studies[29 30] were found to be duplicates of the same study (see figure 1).

Characteristics of included studies

Detailed features of the included studies are reported in online supplemental table 1. 17 studies were included, encompassing 3374 subjects from various geographical backgrounds, including India (n=5),[21 31–34] the USA (n=3),[35–37] Germany (n=2),[22 38] Korea (n=1),[39] Australia (n=1),[29] China (n=1),[40] Egypt (n=1),[41] Bahrain (n=1)[42] and Turkey (n=1).[43] Additionally, one study was a collaborative effort across Germany, France and Great Britain.[44] The total sample size of the intervention groups (silver dressing) was 1709, while the total sample size of the control groups (iodine dressing) was 1541. The number of participants in each study ranged from 11 to 1089. Study participants were presented with a diverse range of wound types, with burn wounds (n=5)[22 31 36 38 39] being the most common and diabetic foot ulcers (n=4)[32 33 41 42] closely following. Other observed wound types included surgical and traumatic wounds (n=2),[43 44] chronic pressure ulcers (n=1),[35] leg ulcers (n=1),[29] cutaneous abscesses (n=1),[37]

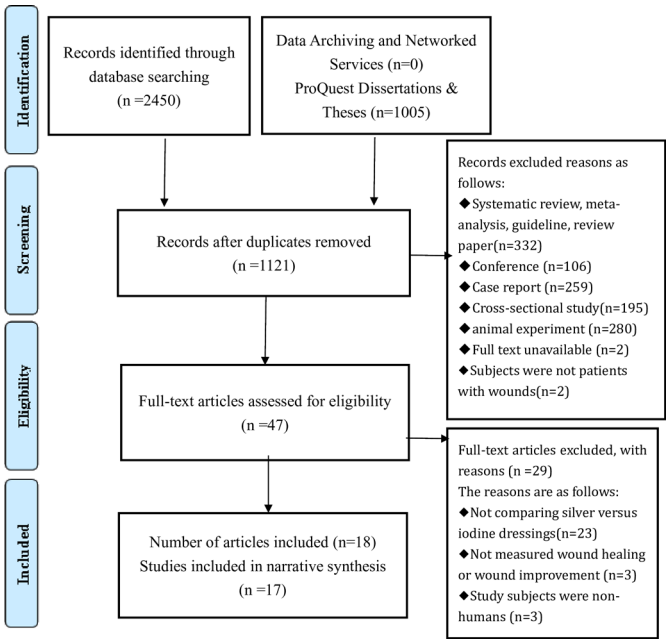

Figure 1 Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow diagram.

infected wounds (n=1),[21] needle stick injuries (n=1)[34] and pemphigus vulgaris (n=1).[40]

Intervention characteristics and measured outcomes

The primary outcomes measured by the included studies (intervention group vs comparison group after intervention) are shown in online supplemental table 2. The silver dressing group consisted of various formulations: silver sulfadiazine cream (n=7),[22 31 34–36 38 40] nanocrystalline silver dressings (n=4),[29 32 33 42] silver-containing hydrofibre dressings (n=3),[37 43 44] silver foam dressing (n=2),[21 39] and SilvrSTAT Gel dressing (n=1).[41] Conversely, the iodine dressing group was primarily represented by povidone-iodine gauze (n=13),[21 31–36 39–44] polyvinylpyrrolidone-iodine (n=2),[22 38] cadexomer iodine (n=1)[29] and iodoform (n=1).[37] The time period from baseline to final assessment ranged from 48 hours to 27 months. Healing time was assessed by time to complete wound healing.[21 22 29 31 39 44] Healing rate was assessed by either determining the percentage change in total wound surface area between two measurements and dividing by the number of days between wound measurements[21 29 31–33 36 41 44] or by observing the change in surface area of cellulitis and abscess at the first follow-up visit (48–72 hours).[37] The amount of exudate was assessed by professional assessment by the investigator (categorised as none, minimal, moderate or heavy) in one study[36 44] or by measuring the time taken for exudate reduction in another study.[21] Pain was assessed using various scales including a 10-point Numeric Rating Scale,[39 40] a 5-point scale for itching point scale, for sensation during dressing changes,[22 36] a Visual Analog Scale[44] or the Wong-Baker Faces Pain Rating Scale.[37] The assessment of anti-infective efficacy included a 7-point scale,[22] reduction of infected wounds,[31 44] leucocyte counts, Gram stain bacterial growth[29] and the mean days to negative cultures[21] or reduced bacterial loads.[33 35] Alternatively, a ratio of infected punctate sites over infection duration was compared with observed sites over the study duration.[34]

Healing time

9 (9/17, 52.9%) out of 17 studies reported on healing time.[21 22 31–33 38–40 44] Among these, two (2/9, 22.2%) studies did not find a significant difference between silver and iodine dressings,[39 44] while four (4/9, 44.4%) studies favoured silver dressings[21 32 33 40] and three (3/9, 33.3%) studies favoured iodine dressings.[22 31 38] Healing time varied from 8 to 71.64 days. Given the omission of SD values in two studies,[31 44] our meta-analysis was predicated on seven studies (7/9, 77.8%), which indicated a statistically significant reduction in healing time with silver dressings compared with iodine treatments (n=7) (SMD=-0.95, 95% CI −1.62 to −0.28, I^2=92%, p=0.005) (figure 2). This implied that silver dressings may offer superior efficacy in accelerating wound healing. The funnel plot was largely symmetrical and there was no apparent publication bias (online supplemental figure 1).

Healing rate

10 (10/17, 58.8%) out of 17 studies reported on healing rate.[21 29 31–33 36 37 41 42 44] Among these, three (3/10, 30%) studies reported no significant differences between silver and iodine dressings,[33 36 44] while six (6/10, 60%) studies indicated superior performance of silver dressings.[21 29 32 37 41 42] One study (1/10, 10%) favoured iodine

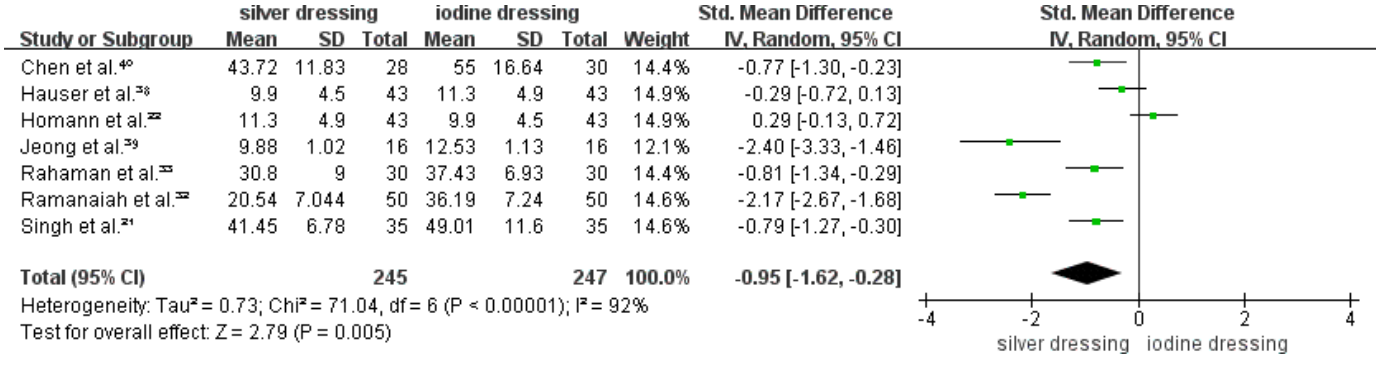

Figure 2 Forest plot of the effect of silver and iodine dressings on wound healing time.

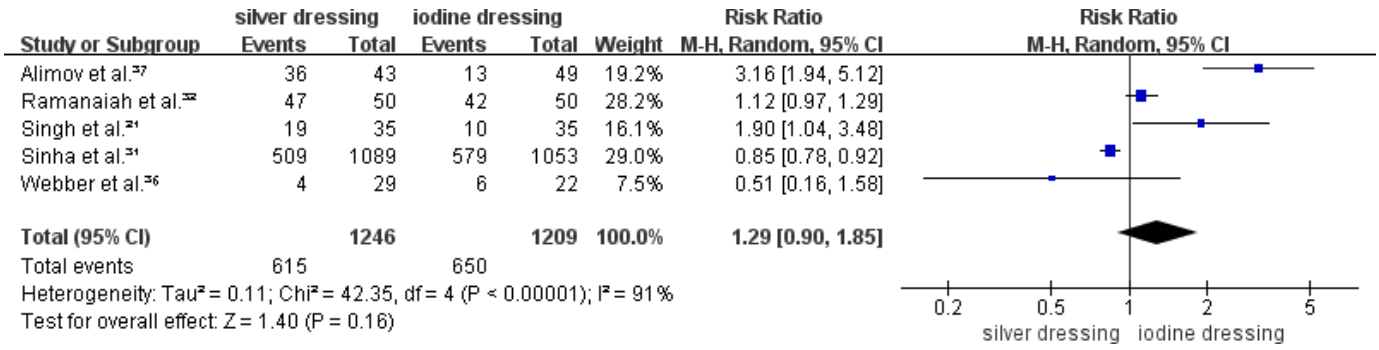

Figure 3 Forest plot of the effect of silver and iodine dressings on wound healing rate.

dressings.[31] Due to the inconsistency in data formats and the inability to standardise to a uniform percentage format, we were constrained to a meta-analysis of only five (5/10, 50%) studies. The pooled RR from the random effects model was 1.29 (RR=1.29, 95% CI 0.90 to 1.85), indicating a non-significant trend towards higher healing rate with silver dressings, although this did not reach statistical significance (Z=1.40, I^2=91%, p=0.16) (figure 3). The symmetrical distribution of points in the funnel plot suggests no evident publication bias, yet conclusions are tentative due to the small sample size (online supplemental figure 2).

Exudate amount

3 (3/17, 17.6%) out of the 17 studies reported on the amount of exudate.[21 36 44] Among the studies, two demonstrated that silver dressings were superior in reducing exudate compared with iodine dressings,[21 44] while one indicated that wounds treated with iodine dressings were significantly drier.[36] However, this difference became non-significant when patients with complicating factors were excluded. Due to disparate expression patterns of exudation reduction across studies, a meta-analysis was not feasible, precluding the aggregation of these data into a pooled estimate.

Pain

7 (7/17, 41.2%) out of the 17 studies reported on the pain.[22 36–40 44] Among them, three studies (3/7, 42.9%) demonstrated that silver dressing was more effective than iodine dressing.[37 40 44] Conversely, four (4/7, 57.1%) studies found no significant differences in pain management scores between the silver and iodine dressing groups.[22 36 38 39] Due to the heterogeneity in pain scoring criteria across studies, a meta-analysis was not feasible.

Anti-infective efficacy

11 (11/17, 64.7%) out of the 17 studies reported on the anti-infective efficacy.[21 22 29 31 33–35 38 40 43 44] Among these, four studies (4/11, 36.4%) reported superior anti-infective outcomes with silver dressings.[21 29 35 43] Conversely, six studies (6/11, 54.5%) found no significant difference in anti-infective efficacy between the dressing groups.[22 33 34 38 40 44] And only one study (1/11, 9.1%) suggested that wounds dressed with iodine exhibited greater resistance to infection.[31] The diversity in methodologies for assessing antimicrobial properties, including bacterial load reduction, sterility duration, infection ratios and efficacy grading, precluded a meta-analysis.

Methodological quality

The risk-of-bias assessment across the included studies is detailed in figure 4. A single study[31] exhibited a high risk of bias in the randomisation sequence due to selective grouping practices. The remaining studies were characterised by low risk of bias in this domain. Allocation concealment was not employed in five studies,[22 33 38 39 44] leading to a high risk of bias in these instances. Only one study[41] explicitly reported the use of blinding for investigators and participants, thus being classified as low risk of bias; the remaining 16 studies were categorised as having high or unclear risk of bias due to the absence of blinding or lack of reporting on this aspect. Furthermore, five studies presented a high risk of bias due to the absence of blinding for outcome assessors.[22 31 33 38 39] All studies maintained a low risk of bias regarding incomplete and selective outcome reporting, as there were no missing data that could potentially influence the study outcomes.

According to the GRADE evaluation, the evidence for healing time was rated as moderate certainty, downgraded one level due to serious inconsistency. The evidence for healing rate was rated as low certainty, downgraded two levels due to serious inconsistency and serious imprecision. Furthermore, the evidence for exudate amount, pain and anti-infective efficacy was rated as low certainty, each downgraded two levels due to serious risk of bias and serious imprecision (see table 1).

DISCUSSION

This review systematically summarised the available evidence on the clinical effects of silver and iodine dressings. It was found that silver dressings are superior to iodine dressings in terms of shortening healing time. Therefore, silver dressings may be an ideal adjuvant material for more effective wound healing compared with iodine dressings.

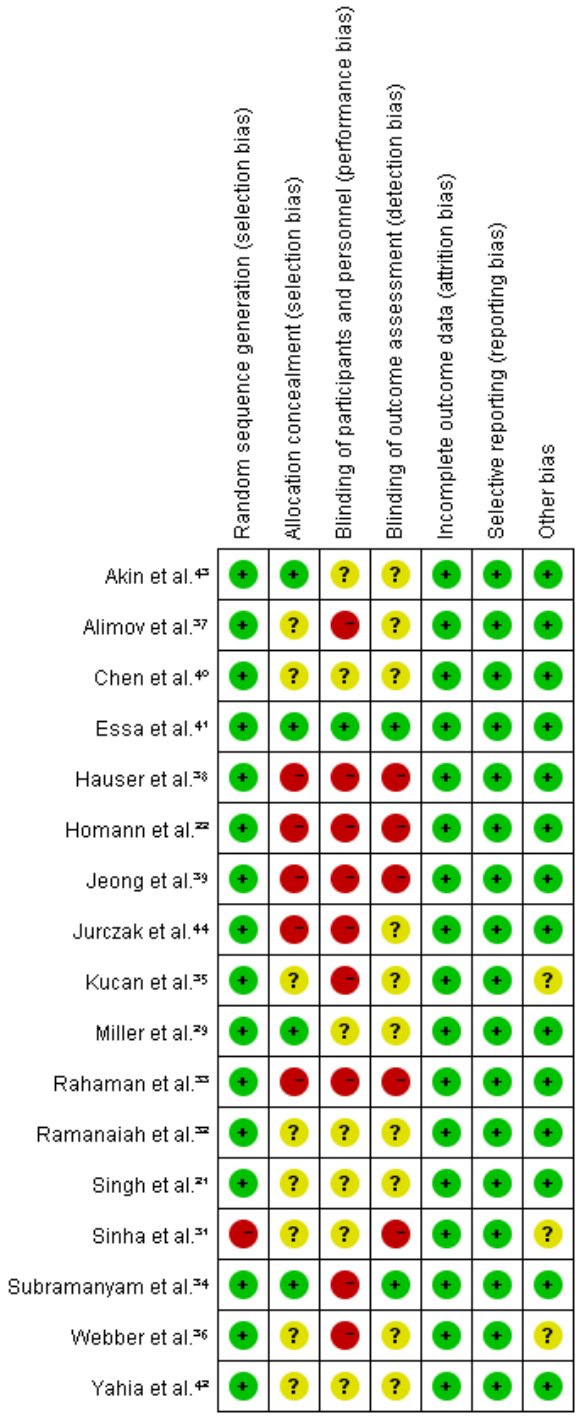

Figure 4 Risk of bias among the included randomised controlled trials according to the Cochrane risk-of-bias tool.

Our meta-analysis showed that silver dressings have an advantage over iodine dressings in reducing healing time. Singh and Apte[21] found that silver dressings resulted in a statistically significant increase in wound capillary proliferation when compared with iodine dressings ($p<0.05$). This scientific finding validates the results of this study. Silver ions in the dressing promote Vascular Endothelial Growth Factor production, stimulate angiogenesis and improve periwound blood flow. In addition, silver ions can also stimulate fibroblasts to differentiate into myofibroblasts, which effectively stimulate wound contraction and accelerate skin remodelling, further promoting wound healing and shortening healing time.[45 46] Two studies showed no significant difference in healing time between the two dressings, but healing time in the silver dressing group was shorter than that in the iodine dressing group. Therefore, compared with iodine dressings, silver dressings are more capable of reducing wound healing time and promoting wound healing.

Healing rate is a crucial indicator used to evaluate the effectiveness of wound recovery. Our meta-analysis did not identify significant statistical differences in healing rate between the two dressings. This finding does not align with a previous meta-analysis, which found that silver dressings were more effective than non-silver dressings in reducing the size of chronic non-healing wounds.[20] Additionally, other research has suggested that silver dressings could be particularly beneficial in the initial stages of wound healing, especially within the first 2 weeks of treatment ($p<0.05$).[33 44] This implies that silver dressings may offer significant advantages during specific crucial early phases of wound healing, even if an overall statistical superiority in healing rate is not conclusively proven. To summarise, silver dressings may have an advantage over iodine dressings in enhancing healing rate, which needs more studies.

In addition, our study found that silver dressing also showed positive and effective application effects in reducing exudate amount and relieving pain compared with iodine dressing. Chaganti *et al*[47] showed that dressings, such as Hydrofiber Ag[44] and silver foam dressings,[21] have unique liquid handling properties and the ability to absorb exudates, which is similar to the results of this study. In addition, Homann *et al*[22] found that nearly 50% of the patients in the iodine dressing group reported unpleasant sensations, such as pain during the application of the excipients, much more than in the silver dressing group. The possible reason is that the silver dressing forms a soft adhesive gel after absorbing a large amount of wound fluid, perfectly fitting the wound and reducing the patient's discomfort and pain.[37]

In terms of anti-infective efficacy, our study found that 54.5% (6/11) of the studies supported that there was no significant difference in anti-infective efficacy between the two dressings, which may be related to the use of antibiotics, changing dressings daily and other factors. The other two studies showed that the anti-infective efficacy of silver dressings was better than that of iodine dressings, probably because the subjects in these two studies had a clinical infection or severe colonisation of the wound.[21 29] Silver, through reliability, is fast and effective at killing critical colonisation, that is, Ag^+ binding to DNA, enzymes and proteins in the cell wall of bacterial cells.[48] Once Ag^+ is attached to these sites, it alters their structure, leading to structural and functional changes in bacterial cells, regulating the ever-present inflammatory response promoting healing and producing long-term clinical

Table 1 Summary of findings

Outcomes	Effect size (95% CI)	Participants (n)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Quality assessment
Healing time	SMD −0.95, (−1.62 to −0.28)	2814 (9 RCTs)	Not serious	Serious (I^2=92% > 60%)	Not serious	Not serious	Not serious	Moderate*
Healing rate	RR 1.29 (0.90 to 1.85)	3001 (10 RCTs)	Not serious	Serious (I^2=91% > 60%)	Not serious	Serious (CI overlaps with no effect)	Not serious	Low†
Exudate amount	N/A	188 (3 RCTs)	Serious (2/3: selection bias)	None	Not serious	Serious (fewer than 400 participants)	None	Low†
Pain	N/A	378 (7 RCTs)	Serious (4/7: selection bias; 6/7: performance bias)	None	Not serious	Serious (fewer than 400 participants)	None	Low†
Anti-infective efficacy	N/A	2904 (11 RCTs)	Serious (5/11: performance bias)	None	Not serious	Serious‡	None	Low†

The outcomes of interest are healing time, healing rate, exudate amount, pain and anti-infective efficacy.
*Moderate certainty: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
†Low certainty: the true effect may be substantially different from the estimate of the effect.
‡On analysis of 11 studies by 2 investigators, and consultation with a third, the notable inconsistencies in the anti-infective efficacy results suggest serious Imprecision in the research area.
RCT, randomised controlled trial; SDM, standardised mean difference.

effects.[49] However, high concentrations (>10%) of iodine ions can induce tissue necrosis, and low concentrations can induce cell apoptosis, limiting the antibacterial effect of iodine dressings.[50]

This is the first systematic review and meta-analysis to generalise and summarise the effects of silver and iodine dressings on promoting wound healing, reinforcing the rigour of this review by including RCTs, using a comprehensive and exhaustive search, a systematic approach to identifying trials and extracting data and using systematic tools to assess bias and overall quality of evidence. In addition, the inclusion of outcome measures such as healing time, healing rate and exudate amount in this study highlights the potential clinical applicability of the findings.

Our study is subject to limitations. Primarily, the evidence quality is limited by the moderate-to-low ratings of the reviewed studies, potentially weakening the strength of our conclusions. Furthermore, the varying adjuvant therapies used in the studies may have impacted wound healing processes, leading to differing outcomes. To address these constraints, future research should focus on using high-quality studies and standardised methodologies to provide a more accurate assessment of the effects of silver dressings on wound healing processes.

In terms of clinical implications, we have observed that silver dressings, acting as an antimicrobial agent, can shorten healing time in most wound treatments. Therefore, when affordable, silver dressings are recommended as a priority. Regarding research implications, more rigorous trials should be conducted to compare the effectiveness of the two dressings. First, considering the potential impact of healthcare system differences on wound care, studies from various geographical areas, including high-income, middle-income and low-income countries, should be encouraged. Second, given the limited number of studies focusing on outcomes like exudate reduction and pain when comparing silver and iodine dressings, additional research is required. Third, future studies should provide more detailed data on wound infections to reach definitive conclusions about the anti-infective efficacy of silver and iodine dressings.

CONCLUSIONS

This systematic review and meta-analysis provides robust evidence that silver dressings markedly accelerate wound healing time compared with iodine dressings, without a corresponding impact on healing rate. The findings on silver dressings' effects on exudate amount, pain and anti-infective efficacy are inconsistent and derived from studies of variable quality. Despite these limitations, the collective research implies that silver dressings may be a viable clinical option for wound care, specifically in hastening the healing timeline. Nonetheless, the dearth and heterogeneity of existing studies necessitate further well-designed research to delineate unequivocal clinical protocols.

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Contributors YJ and QZ: Database retrieval, data extraction and verification, statistical analysis and interpretation, manuscript writing and submission of manuscripts. HW, MV and QZ: Revise the manuscript. WD and JG: Manuscript revision, statistical analysis, study supervision and act as a guarantor for the overall work. All authors read and approved the final manuscript.

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Patient consent for publication Not applicable.

Ethics approval Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data sharing not applicable as no datasets generated and/or analysed for this study. No data are available.

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Supplemental Material

Supplemental Material 1: Full search strategy

Supplemental Material 2: Studies ineligible following full-text review

Supplementary Table 1: Characteristics of the included studies

Supplementary Table 2: Inclusion of the primary outcome measured by the studies (intervention group vs comparison group)

Supplementary Figure 1: Funnel plots of seven studies comparing wound healing time with silver and iodine dressings

Supplementary Figure 2: Funnel plots of five studies comparing wound healing rate with silver and iodine dressings

Supplemental Material 1: Full search strategy

PubMed

1940-present

#	Search	Result
1	" Wounds and Injuries"[MeSH Terms] OR "Wound Infection"[MeSH Terms] OR "Wound Healing"[MeSH Terms] OR "Surgical Wound Infection"[MeSH Terms] OR "Surgical Wound Dehiscence"[MeSH Terms] OR "Surgical Wound"[MeSH Terms] OR "wounds, stab"[MeSH Terms] OR "wounds, penetrating"[MeSH Terms] OR "wounds, gunshot"[MeSH Terms] OR "Multiple Trauma"[MeSH Terms] OR "wound*"[All Fields] OR "injur*"[All Fields] OR "trauma*"[All Fields]	2419742
2	"silver"[MeSH Terms] OR "silver*"[All Fields]	171084
3	"iodine"[MeSH Terms] OR "iodin*"[All Fields]	135649
4	#1 AND #2 AND #3	222

Cochrane Library

1993 to present

#	Search	Result
1	MeSH descriptor: [Wounds and Injuries] explode all trees	38676
2	MeSH descriptor: [Wound Infection] explode all trees	5177
3	MeSH descriptor: [Wound Healing] explode all trees	8208
4	MeSH descriptor: [Surgical Wound Infection] explode all trees	4576
5	MeSH descriptor: [Surgical Wound Dehiscence] explode all trees	559
6	MeSH descriptor: [Surgical Wound] explode all trees	566
7	MeSH descriptor: [Wounds, Stab] explode all trees	137
8	MeSH descriptor: [Wounds, Penetrating] explode all trees	426
9	MeSH descriptor: [Wounds, Gunshot] explode all trees	77
10	MeSH descriptor: [Multiple Trauma] explode all trees	319

11	(wound* OR injur* OR trauma*)	145422
12	#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11	157800
13	MeSH descriptor: [Silver] explode all trees	306
14	(silver*)	8768
15	#13 OR #14	8768
16	MeSH descriptor: [Iodine] explode all trees	1750
17	(iodin*)	6711
18	#16 OR #17	6711
19	#12 AND #15 AND #18	105

Embase

Elsevier / 1974- present

#	Search	Result
1	'injury'/exp OR 'injury' OR 'wound infection'/exp OR 'wound infection' OR 'wound healing'/exp OR 'wound healing' OR 'surgical infection'/exp OR 'surgical infection' OR 'wound dehiscence'/exp OR 'wound dehiscence' OR 'surgical wound'/exp OR 'surgical wound' OR 'stab wound'/exp OR 'stab wound' OR 'penetrating trauma'/exp OR 'penetrating trauma' OR 'gunshot injury'/exp OR 'gunshot injury' OR 'multiple trauma'/exp OR 'multiple trauma'	3441405
2	'silver'/exp OR 'silver'	183532
3	'iodine'/exp OR 'iodine'	172148
4	#1 AND #2 AND #3	895

Web of Science:

All Databases / 1637-present

#	Search	Result
1	TS=(wound* OR injur* OR trauma*)	3845202
2	TS=(silver*)	3689570

3	TS=(iodin*)	214321
4	(#3 AND #2 AND #1)	342

CINAHL

EBSCO-host / 1963-present

#	Search	Result
1	((MM "Wounds and Injuries+") OR (MM "Wound Healing+") OR (MM "Surgical Wound Infection") OR (MM "Surgical Wound Dehiscence") OR (MM "Surgical Wound") OR (MM "Wounds, Stab") OR (MM "Wounds, Penetrating+") OR (MM "Wounds, Gunshot") OR (MM "Multiple Trauma")) OR TX (wound* OR injur* OR trauma*))	818648
2	(MM "Silver") OR TX silver*	62750
3	(MM "Iodine") OR TX iodin*	15883
4	#1 AND #2 AND #3	886

Data Archiving and Networked Services

#	Search	Result
1	Any fielid: wound? OR injur? OR trauma?	746
2	Any fielid: silver?	23
3	Any fielid: iodin?	80
4	#1 AND #2 AND #3	0

ProQuest Dissertations & Theses Global

#	Search	Result
1	mainsubject(Wounds and Injuries) OR mainsubject(Wound Infection) OR mainsubject(Wound Healing) OR mainsubject(Surgical Wound Infection) OR mainsubject(Surgical Wound Dehiscence) OR mainsubject(Surgical Wound) OR mainsubject(wounds, stab) OR mainsubject(wounds, penetrating) OR mainsubject(wounds, gunshot) OR mainsubject(Multiple Trauma)	65675

2	wound? OR injur? OR trauma?	3617670
3	#1 AND #2	3617670
4	mainsubject(silver) OR silver*	1534747
5	mainsubject(iodine) OR iodin*	264206
6	#3 AND #4 AND #5	1005

Supplemental Material 2: Studies ineligible following full-text review

[1] Woodmansey EJ, Roberts CD. Appropriate use of dressings containing nanocrystalline silver to support antimicrobial stewardship in wounds. Int Wound J. 2018;15(6):1025-1032. doi: 10.1111/iwj.12969

Reason for exclusion: There is no comparison between silver and iodine dressings.

[2] Steffi W, Zaliana B, Amreen A, Nasirudin N. Management of malodour fungating wound with nanocrystalline silver coated dressing. Med J Malaysia. 2017 Oct;72(5):316-317

Reason for exclusion: There is no comparison between silver and iodine dressings.

[3] Kalemikerakis J, Vardaki Z, Fouka G, Vlachou E, Gkovina U, Kosma E, Dionyssopoulos A. Comparison of foam dressings with silver versus foam dressings without silver in the care of malodorous malignant fungating wounds. J BUON. 2012;17(3):560-4.

Reason for exclusion: Control group is not iodine dressing.

[4] Wang J, Smith J, Babidge W, Maddern G. Silver dressings versus other dressings for chronic wounds in a community care setting. J Wound Care. 2007;16(8):352-6. doi: 10.12968/jowc.2007.16.8.27857.

Reason for exclusion: Control group is not iodine dressing.

[5] Gupta S, Andersen C, Black J, de Leon J, Fife C, Lantis Ii JC, Niezgoda J, Snyder R, Sumpio B, Tettelbach W, Treadwell T, Weir D, Silverman RP. Management of Chronic Wounds: Diagnosis, Preparation, Treatment, and Follow-up. Wounds. 2017;29(9): S19-S36.

Reason for exclusion: There is no comparison between silver and iodine dressings.

[6] Verma J, Kanoujia J, Parashar P, Tripathi CB, Saraf SA. Wound healing applications of sericin/chitosan-capped silver nanoparticles incorporated hydrogel. Drug Deliv Transl Res. 2017 ;7(1):77-88. doi: 10.1007/s13346-016-0322-y.

Reason for exclusion: There is no comparison between silver and iodine dressings.

[7] Chang FY, Chang MC, Wang ST, Yu WK, Liu CL, Chen TH. Can povidone-iodine solution be used safely in a spinal surgery? Eur Spine J. 2006;15(6):1005-14. doi: 10.1007/s00586-005-0975-6.

Reason for exclusion: Control group is not silver dressing.

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Reason for exclusion: There is no comparison between silver and iodine dressings.

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Reason for exclusion: There is no comparison between silver and iodine dressings.

[10] Sinha R, Agarwal RK, Agarwal M. Povidone iodine plus neosporin in superficial burns--a continuing study. Burns. 1997 Nov-Dec;23(7-8):626-8. doi: 10.1016/s0305-4179(97)00069-7

Reason for exclusion: Control group is not silver dressing.

[11] Schwartz JA, Lantis JC 2nd, Gendics C, Fuller AM, Payne W, Ochs D. A prospective, non comparative, multicenter study to investigate the effect of cadexomer iodine on bioburden load and other wound characteristics in diabetic foot ulcers. Int Wound J. 2013;10(2):193-9. doi: 10.1111/j.1742-481X.2012.01109.x.

Reason for exclusion: Control group is not silver dressing.

[12] Ousey K, McIntosh C. Topical antimicrobial agents for the treatment of chronic wounds. Br J Community Nurs. 2009;14(9): S6, S8, S10 passim. doi: 10.12968/bjcn.2009.14.Sup4.43909.

Reason for exclusion: There is no comparison between silver and iodine dressings.

[13] Brown M, Dalziel SR, Herd E, Johnson K, Wong She R, Shepherd M. A Randomized Controlled Study of Silver-Based Burns Dressing in a Pediatric Emergency Department. J Burn Care Res. 2016;37(4):e340-7. doi: 10.1097/BCR.0000000000000273.

Reason for exclusion: Control group is not iodine dressing.

[14] Verbelen J, Hoeksema H, Heyneman A, Pirayesh A, Monstrey S. Aquacel(®) Ag dressing versus Acticoat™ dressing in partial thickness burns: a prospective, randomized, controlled study in 100 patients. Part 1: burn wound healing. Burns. 2014 May;40(3):416-27. doi: 10.1016/j.burns.2013.07.008

Reason for exclusion: Control group is not iodine dressing.

[15] Gee Kee EL, Kimble RM, Cuttle L, Khan A, Stockton KA. Randomized controlled trial of three burns dressings for partial thickness burns in children. Burns. 2015 Aug;41(5):946-55. doi: 10.1016/j.burns.2014.11.005

Reason for exclusion: Control group is not iodine dressing.

[16] He J, Qiao Y, Zhang H, Zhao J, Li W, Xie T, Zhong D, Wei Q, Hua S, Yu Y, Yao K, Santos HA, Zhou M. Gold-silver nanoshells promote wound healing from drug-resistant bacteria infection and enable monitoring via surface-enhanced Raman scattering imaging. Biomaterials. 2020; 234:119763. doi: 10.1016/j.biomaterials.

Reason for exclusion: Control group is not iodine dressing.

[17] Gwak HC, Han SH, Lee J, Park S, Sung KS, Kim HJ, Chun D, Lee K, Ahn JH, Kwak K, Chung HJ. Efficacy of a povidone-iodine foam dressing (Betafoam) on diabetic foot ulcer. Int Wound J. 2020;17(1):91-99. doi: 10.1111/iwj.13236.

Reason for exclusion: Control group is not silver dressing.

[18] Ammons MC. Anti-biofilm strategies and the need for innovations in wound care.Recent Pat Antiinfect Drug Discov. 2010;5(1):10-7. doi: 10.2174/157489110790112581

Reason for exclusion: There is no comparison between silver and iodine dressings.

[19] Thammawithan S, Siritongsuk P, Nasompag S, Daduang S, Klaynongsruang S, Prapasarakul N, Patramanon R. A Biological Study of Anisotropic Silver Nanoparticles and Their Antimicrobial Application for Topical Use. Vet Sci. 2021 Aug 31;8(9):177.

Reason for exclusion: The study was excluded from our meta-analysis due to its focus on non-human subjects, specifically cultured bacterial colonies, which diverges from our goal of examining human-related research.

[20] Davis SC, Gil J, Solis M, Higa A, Mills A, Simms C, Pena PV, Li J, Raut V. Antimicrobial effectiveness of wound matrices containing native extracellular matrix with polyhexamethylene biguanide. Int Wound J. 2022 Jan;19(1):86-99.

Reason for exclusion: The study was excluded for not providing key outcomes: healing time, rate, exudation reduction, pain, and anti-infective efficacy.

[21] Prezzavento GE, Mas CR, Achaval Rodríguez J, Juárez Calvi RN, Piskulic L, Angelini J, Allasia MB, Smania AM, Moyano AJ. Comparison of Efficacy of Povidone-Iodine, Ethanol, and an Aerosol Formulation of Silver Sulfadiazine in Controlling Microbial Burden on Sutures From Clean Surgeries. J Burn Care Res. 2021 Sep 30;42(5):975-980.

Reason for exclusion: The study was excluded for not providing key outcomes: healing time, rate, exudation reduction, pain, and anti-infective efficacy.

[22] Cox SG, Cullingworth L, Rode H. Treatment of paediatric burns with a nanocrystalline silver dressing compared with standard wound care in a burns unit: a cost analysis. S Afr Med J. 2011 Sep 27;101(10):728-31.

Reason for exclusion: The study was excluded for not providing key outcomes: healing time, rate, exudation reduction, pain, and anti-infective efficacy.

[23] Lantis JC 2nd, Gendics C. In vivo effect of sustained-release silver sulphadiazine foam on bioburden and wound closure in infected venous leg ulcers. J Wound Care. 2011 Feb;20(2):90-6.

Reason for exclusion: The study was not a randomized controlled trial and lacked a control group.

[24] Kaiser W, von der Lieth H, Potel J, Heymann H. Tierexperimentelle Untersuchungen zur lokalen Anwendung von Silbersulfadiazin, Cefsulodin und PVP-Jod bei Brandwunden [Experimental study of the local application of silver sulfadiazine, cefsulodin and povidone-iodine in burns]. Infection. 1984 Jan-Feb;12(1):31-5.

Reason for exclusion: The study was based on animal testing.

[25] Robson MC, Schaerf RH, Krizek TJ. Evaluation of topical povidone-iodine ointment in experimental burn wound sepsis. Plast Reconstr Surg. 1974 Sep;54(3):328-34.

Reason for exclusion: The study was based on animal testing.

[26] Michaels JA, Campbell WB, King BM, Macintyre J, Palfreyman SJ, Shackley P, Stevenson MD. A prospective randomised controlled trial and economic modelling of antimicrobial silver dressings versus non-adherent control dressings for venous leg

ulcers: the VULCAN trial. Health Technol Assess. 2009 Nov;13(56):1-114, iii.
Reason for exclusion: Control group is not iodine dressing.
[27] Fumal I, Braham C, Paquet P, Piérard-Franchimont C, Piérard GE. The beneficial toxicity paradox of antimicrobials in leg ulcer healing impaired by a polymicrobial flora: a proof-of-concept study. Dermatology. 2002;204 Suppl 1:70-4.
Reason for exclusion: The study does not include comparative analysis of silver and iodine dressings.
[28] Wiese KR, van Heukelum M, Lombard CJ, Ferreira N, Burger MC. Randomized Controlled Trial Comparing Silver-Impregnated Fibrous Hydrocolloid Dressings With Silver Sulfadiazine Cream Dressings for the Treatment of Fracture Blisters to Determine Time to Surgical Readiness. J Orthop Trauma. 2021 Aug 1;35(8):442-447.
Reason for exclusion: The study does not include comparative analysis of silver and iodine dressings.
[29] Mehl AA, Damião AO, Viana SD, Andretta CP. Hard-to-heal wounds: a randomised trial of an oral proline-containing supplement to aid repair. J Wound Care. 2021 Jan 2;30(1):26-31.
Reason for exclusion: The study does not include comparative analysis of silver and iodine dressings.

Supplemental Table 1. Characteristics of the included studies

Reference	Wounds Type	Country	Sample size	Type of dressing	Area of wound	Frequency of dressing change	Category of measured Outcomes
Kucan, 1981	chronic pressure ulcers	USA	N0=15 N1=11	N0: Silver sulfadiazine cream N1: Povidone-iodine solution	N/A	N0：Every eight hours N1：Every six hours	(1) Anti-infective efficacy
Sinha, 1997	superficial burn injury	India	N0=1089 N1=1053	N0: Silver sulphadiazine N1: Povidone iodine plus neosporin	N/A	N0: Twice daily N1: Replace no more than every 12 hours, for up to three times a day.	(1) Healing time; (2) Healing rate; (3) Anti-infective efficacy
Webber, 1977	second-degree burns over less than 15% of the body surface area (less than 5% in children)	USA	N0=29 N1=22	N0: Silver sulfadiazine N1: Povidone-iodine	N/A	N/A	(1) Healing rate; (2) Pain; (3) Exudate amountd
Hauser, 2007	Fresh IIa burns, 36-300cm², no infection, ≤3 days.	Germany	N0=43 N1=43	N0: Silver-sulfadiazine cream N1: Liposome Polyvinyl-Pyrrolidone Iodine hydrogel	N0: 79.3cm^2; N1: average area is 77.3cm^2	Once a day	(1) Healing time; (2) Pain; (3) Anti-infective efficacy

Homann, 2007	burn wounds (degree IIa) not older than 3 days	Germany	N0=43 N1=43	N0: Silver-sulfadiazine cream N1: Liposome Polyvinyl-Pyrrolidone Iodine hydrogel	N0:79.2cm^2; N1:50 cm^2	Once a day	(1) healing time (2) anti-infective efficacy
Jurczak, 2007	Surgical and traumatic wounds	Germany France Great Britain	N0=35 N1=32	N0: Hydro fiber Ag dressing; N1: povidone–iodine gauze	N0:4050mm^2 N1:15200mm^2	N0：Once every 7 days N1：N/A	(1) healing time (2) healing rate (3) Exudate amount (4) pain (5) anti-infective efficacy
Miller, 2010	Leg ulcer	Australia	N0=140 N1=141	N0: Nanocrystalline silver; N1: Cadexomer iodine	N0: 596.96 mm^2 N1:812.37 mm^2	N/A	(1) healing rate (2) anti-infective efficacy
Alimov, 2013	Cutaneous abscesses	USA	N0=43 N1=49	N0: Silver-containing hydro fiber dressing; N1: Iodoform Packing strips	N/A	N/A	(1) healing rate (2) pain
Singh, 2014	Infected wounds	India	N0=35 N1=35	N0: Silver foam Dressing;	N/A	once a day	(1) healing time (2) healing rate (3) Exudate amount

				N1: Polyvinyl-Pyrrolidone Iodine dressing			(4) anti-infective efficacy
Ramanaiah, 2015	Diabetic foot	India	N0=50 N1=50	N0: Nanocrystalline silver dressing; N1: Betadine gauze	N/A	N/A	(1) healing rate
Rahaman, 2017	Diabetic foot	India	N0=30 N1=30	N0: Nanocrystalline silver; N1: Povidone iodine dressing	N/A	N/A	(1) healing rate (2) anti-infective efficacy
Subramanyam, 2019	Needle stick injuries	India	N0=27 N1=27	N0: Silver sulfadiazine N1: Povidone iodine	N/A	N/A	(1) anti-infective efficacy
Jeong, 2019	Acute partial thickness burns	Korea	N0=16 N1=16	N0: Silver foam dressing; N1: Polyurethane foam dressing containing 3% povidone-iodine	5% of the body surface area	Once every other day	(2) healing time (3) pain
Chen, 2020	Pemphigus vulgaris	China	N0=28 N1=30	N0: Physiotulle Ag; N1: diluted povidone iodine solution (0.5%)		N0: Once every 3-4 days; N1: once a day	(1) healing time (2) anti-infective efficacy (3) pain

Yahia, 2021	diabetic foot ulcers	Bahrain	N0=30 N1=30	N0: hydrogel/nano silver wound dressing N1: Povidone iodine	N0:2582.8sq mm; N1:5746.2sq mm	N0: once a day; N1: Once every two days	(1) healing time; (2) healing rate
Essa, 2021	nonischemic diabetic foot ulcers	Egypt	N0=40 N1=40	N0: SilvrSTAT Gel dressing; N1: Povidone iodine	N/A	N0: once a day; N1: Once every three days	(1) healing rate
Akin, 2022	Closed abdominal incision after colostomy	Turkey	N0=16 N1=16	N0: Silver-contraining hydrofiber dressing; N1: Povidone iodine	N/A	N0: once a day; N1: Once every 5 days	(1) anti-infective efficacy

Note: N0 means the silver dressing group, N1 means the iodine dressing group.

Supplemental Table 2. Inclusion of the primary outcome measured by the studies (intervention group vs comparison group)

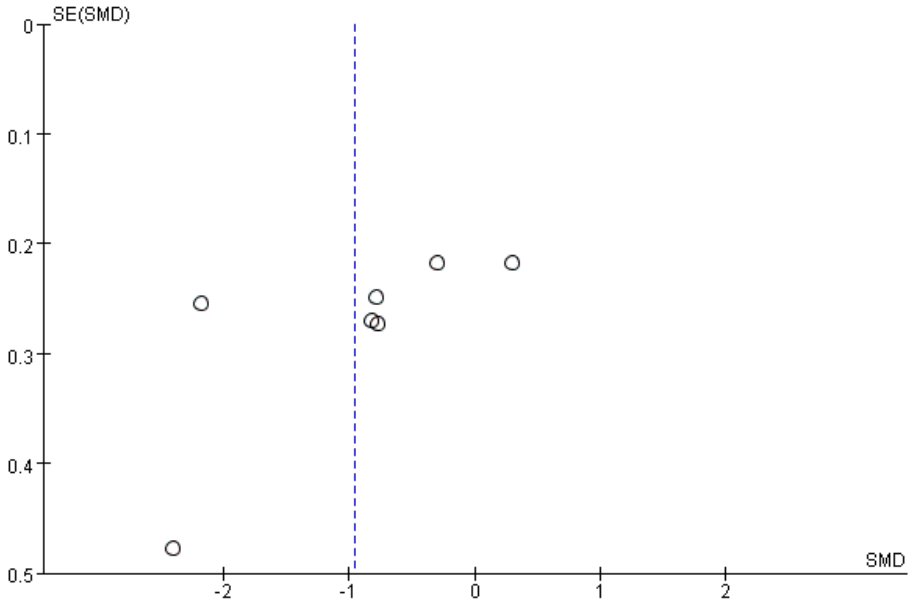
Study	Healing time	Healing rate	Exudate amount	Pain	Anti-infective efficacy
Kucan, 1981	N/A	N/A	N/A	N/A	↑Significant difference in mean bacterial levels (100% VS 63.6%, $P < 0.01$)
Sinha, 1997	↓Patients with burns <50% healed significantly faster within 15 days (P<0.001), and those with >50% burns showed superior healing up to 45 days post-admission with PVP+N treatment (P<0.001).	↓46.72% VS 54.40%	N/A	N/A	↓Fewer infections on days 7 and 18 in the povidone iodine plus Neosporin group ($P < 0.01$ and $P < 0.01$, respectively).
Webber, 1997	N/A	13.6% VS 27.6%, No difference	↓The difference in wound dryness between Povidone-iodine and Silver sulfadiazine was significant overall but not when excluding patients with complicating factors.	No difference	N/A

Hauser, 2007	↓9.9±4.5 VS 11.3±4.9 days, $P = 0.015$	N/A	N/A	Pain occurred with the same frequency and severity in both groups.	No wound infection occurred in the two groups.
Homann, 2007	↓9.9±4.5 vs 11.3±4.9 days, $P = 0.015$	N/A	N/A	No difference	No difference
Jurczak, 2007	No difference	No difference	↑Management "Excellent" or "good" (94% vs 52%, $P < 0.001$)	↑Pain score: excellent (70.6% vs 22.6%, $P < 0.001$)	No difference
Miller, 2010	N/A	↑Faster healing in first 2 weeks: $F = 9.16$, $P < 0.01$; ↑no healing in 12 weeks: $F = 4.19$, $P < 0.05$.	N/A	N/A	↑Wound healing was faster in the first 2 weeks with nil or low bacterial levels, but no difference was seen with moderate-to-heavy growth.
Alimov, 2013	N/A	↑Significant 30%+ reduction in abscess area 48-72h (82.6% vs 26.1%, $P < 0.001$) no difference in cellulitis reduction 10-14 days.	N/A	↑Reduction in pain intensity from initial to 48-72h later ($F1,63 = 4.25$, $P = 0.043$)	N/A

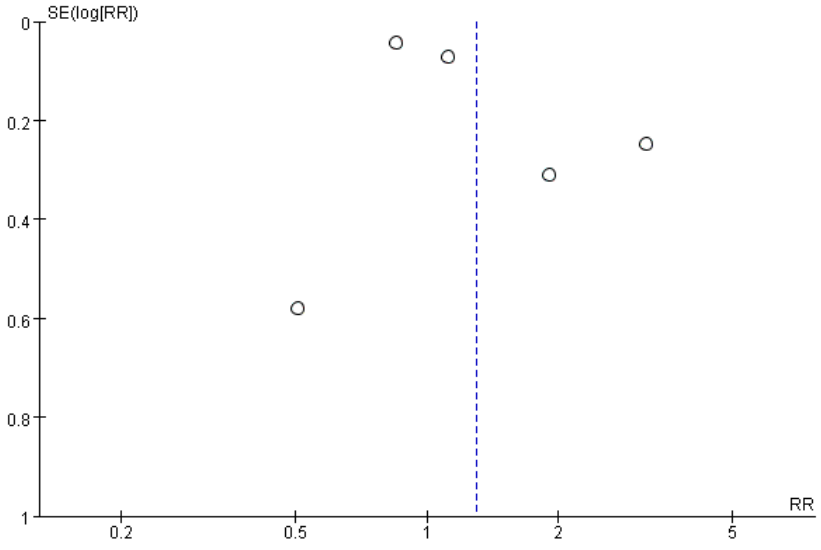
Singh, 2014	↑51-100cm^2 48.22 VS 57.2 days , P = 0.0058	↑1-50cm^2 wound size reduction at day 28 (76.45% vs 57.29%, P < 0.001) ↑51-100cm^2 reduction at day 28 (53.06% vs 28.63%, P < 0.001)	↑Exudate reduction time: 1.6 days vs 18.91 days (P < 0.0001)	N/A	↑Mean number of days taken to achieving no growth in pus culture (9.60 vs 14.63 days, P < 0.001).
Ramanaiah, 2015	↑20.54±7.04 vs 36.19±7.24 days P < 0.01	↑Percentage reduction of ulcer (94.81% vs 84.69%, P < 0.001)	N/A	N/A	N/A
Rahaman, 2017	↑30.80±9.00 vs 37.43±6.93 days, P = 0.002	No difference	N/A	N/A	No difference
Subramanyam,2019	N/A	N/A	N/A	N/A	P = 0.35
Jeong, 2019	12.53±1.13 vs 9.88±1.02 days, P = 0.1556	N/A	N/A	No difference	N/A
Chen, 2020	↑43.72±11.85 vs 55.00±16.64 days, P = 0.008	N/A	N/A	↑NRS scores: 2.71±0.65vs3.62±0.99 , P < 0.0001	No difference
Yahia, 2021	N/A	↑The hydrogel / nanosilver-based dressing group had a	N/A	N/A	N/A

		higher healing rate of ulcer			
Essa, 2021	N/A	↑Ulcer healing rate weekly: 0.68±0.07 vs 0.47±0.04 ($P < 0.001$)	N/A	N/A	N/A
Akin, 2022	N/A	N/A	N/A	N/A	↑Incidence of infection: 26.7% vs 0, $P = 0.043$

Note:↑indicate silver dressing had significant result，↓indicate idiom dressing had significant result



Supplemental Figure 1. Funnel plots of seven studies comparing wound healing time with silver and iodine dressings



Supplemental Figure 2. Funnel plots of five studies comparing wound healing rate with silver and iodine dressings