Comparative effectiveness and cost assessment of polymer dressings for acute partial-thickness burns: a systematic review and meta-analysis

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ABSTRACT

Partial-thickness burns pose a significant clinical challenge globally. While conventional treatments like silver sulfadiazine (SSD) remain common, polymer-based dressings have emerged as effective alternatives. These dressings aim to relieve pain, speed healing, minimise frequent changes and improve cost-effectiveness. This systematic review and meta-analysis evaluate polymer-based dressings' efficacy, tolerability, and economic implications in treating acute partial-thickness burns.

Seven electronic databases (PubMed, Scopus, CINAHL, Cochrane Clinical Trials, Medline, Embase, and Web of Science) were searched from 1990 to March 2025, following PRISMA guidelines. Randomised controlled trials (RCTs) and comparative cohort studies evaluating polymer-based dressings versus traditional treatments (such as SSD and paraffin gauze) or other polymer dressings were included. These studies were categorised into silver-based, non-silver-based, and multiple polymer dressings. The risk of bias was assessed using the RoB 2 and ROBINS-I tools. A meta-analysis on pain scores and healing times was performed, using standardised mean differences (SMD) and visualised through forest and funnel plots.

Twenty-nine studies were included in the qualitative synthesis, with seven suitable for meta-analysis. Findings showed significant pain score reductions for polymer dressings compared to SSD (SMD=-0.61, 95% CI: -0.99 to -0.22), paraffin gauze (SMD=-0.96, 95% CI: -1.21 to -0.70), and other polymers (SMD=-0.71, 95% CI: -0.79 to -0.63). The polymer group also significantly improved healing time over SSD (SMD=-1.05, 95% CI: -1.38 to -0.71). Mepilex Ag consistently demonstrated benefits in pain relief, fewer dressing changes, and cost-effectiveness, followed by Aquacel Ag and Askina Calgitrol Ag. Non-silver dressings, such as bacterial cellulose and chitosan-based materials, had positive results, especially in pain management and patient comfort. Polymer-based dressings like Mepilex Ag and Aquacel Ag yield superior outcomes and economic value for acute partial-thickness burns.

Keywords cost assessment, polymer dressings, acute partial-thickness, burns, pain management

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BACKGROUND

Burns are ranked the fourth most prevalent injury globally, making them the most encountered in clinical practice. During treatment, fluid loss and infections present a significant challenge.[1] Though deep burns invariably require surgical interventions and skin grafting, superficial burns can be treated with dressings. Various dressings have appeared in the past decades to treat superficial burns.[2] An effective wound dressing is a barrier that prevents fluid loss through the skin, reduces the risk of infection, supports the re-epithelialisation of the wound's surface, is cost-efficient and user-friendly, and helps manage pain. Although several dressings are in use, there is insufficient conclusive data on the best treatment choice.[3] This leads to the quest to find the best dressing for partial-thickness burns.

Burn wounds are usually treated with debridement and disinfection, external drug or dressing application, and splinting in the clinical setting. External dressings have proven effective in minimising wound infections and enhancing healing. However, selecting external application materials can directly influence the wound healing rate.[4] The choice of dressings is limitless, with innovations around the corner, but accessibility and cost hugely affect the choice. Various treatment options are available, ranging from conventional 1% silver sulphadiazine gauze dressings to more modern material dressings that may be drug-eluting or nano-silver particle-based.[5] A polymer is a macromolecule composed of repeating structural units (monomers) connected by covalent chemical bonds, typically in long chains. Depending on their structure, these can be natural or synthetic and show diverse physical and chemical properties.[6] Polymer-based wound dressings are natural or synthetic polymeric substances that cover wounds, maintain moisture balance, protect against infections, and promote tissue regeneration. They may be films, foams, hydrogels, hydrocolloids or nanofiber scaffolds.[7]

This review aims to find whether polymer dressings are superior to conventional methods, and which polymer is an ideal choice for the treatment.

Previous systematic reviews and health technology assessments, including those conducted by Cochrane and NICE, have evaluated advanced dressings for burn and wound care, generally concluding that some alternatives to silver sulfadiazine may improve healing and patient comfort. However, many of these reviews are now dated, focus on a limited range of dressings, or provide narrative rather than quantitative synthesis. The present study adds new information by incorporating more recent trials, performing an updated meta-analysis with broader coverage of polymer-based dressings, and emphasising outcomes, such as pain scores, frequency of dressing change, and cost-effectiveness, which have not been comprehensively analysed in prior reviews.

METHODOLOGY

For this review, we examined seven electronic databases: PubMed, Scopus, CINAHL (EBSCOhost), Cochrane Clinical Trials, Medline (OVID), Embase (OVID), and Web of Science. The search included data from 1990 to March 2025 and was guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) foundation.[8] This review is registered with PROSPERO 2025 CRD420251043622.[9]

Literature search

Boolean operators were applied between search terms to create complex search strategies. The keywords used include: 'cellulose', 'carboxy methyl cellulose', 'hydrogel', 'hydrocolloids', 'chitosan', 'alginates', 'collagen', 'polyurethane', 'silicones', 'silver dressings', 'silver nanoparticles', 'silver sulfadiazine', 'paraffin gauze', 'Vaseline dressings', 'biological dressings', 'occlusive dressings', 'acute burn injury', 'thermal burns', 'contact burns', 'chemical burns', 'scalds', 'electric burns' and 'humans'.

Inclusion criteria

1. Original articles in English or their translations.
2. Randomised Controlled Trials (RCTs) and cohort studies. Studies comparing polymer dressings with traditional burn dressings or between polymer dressings.
3. Studies focused on dressings for acute partial thickness burns covering less than 40% total body surface area (TBSA).
4. Studies that report healing time or rate, pain scores, and dressing change frequency (primary outcomes).
5. Studies published in peer-reviewed journals.

Exclusion criteria

1. Case reports, reviews, non-human studies, and studies published in languages other than English.
2. Studies on xenografts, donor site dressings or dressings for graft sites.
3. Studies lacking a control group or quantitative primary outcome data.

Data abstraction

Papers were screened using Rayyan.ai and categorised into three groups: silver-based dressings; non-silver-based dressings; and multiple dressings comparison. The dressings were compared to standard treatments (silver ointment, petroleum jelly or antibiotic ointment dressings) or another polymer dressing.

The studies assessed mean age, TBSA% of burns, healing time, and patient healing rates. Pain scores (VAS 0–10 or 0–100), number of dressing changes, and cost effectiveness were also analysed. If data was sufficient, additional parameters like infection rate, long-term scarring, and hospitalisation days were evaluated.

Quality assessment

The risk of bias analysis was conducted using the RoB 2 tool for RCTs and the ROBINS-I tool for comparative studies.[10-11] Studies with moderate risk, serious risk (ROBINS-I) and some risks (Rob 2) were included only if they had complete and valuable data.

Data analysis

As shown in Figure 1, 2472 research papers were retrieved after searching all databases, including 816 duplicates. Both authors screened the remaining 1611 papers by title and abstract, excluding 1238. Full text screening was performed on 373 papers; two were unavailable due to subscription issues. Only 29 studies were included for qualitative synthesis, categorised into three groups for analysis. Seven studies qualified for meta-analysis. All meta-analytic calculations and visualisations (forest plots, funnel plots, risk of bias charts, GRADE summary chart) were produced using open-source Python packages: Statsmodels, Matplotlib, Pandas, and NumPy for standardised mean difference calculations, confidence interval generation, and plotting as per Cochrane guidelines.[12-15] (Supplementary Table 2).

Statistical analysis

The primary outcome measured was the healing (re-epithelialisation) time or rate after the study. Secondary outcomes included pain scores (VAS 0–10/ VAS 0–100 or analgesic usage), total and daily dressing changes per patient, and overall cost-effectiveness comparing treatment costs. The studies were divided into groups A, B and C. Key findings for each group are outlined below.

ROBINS-I for cohort studies and RoB 2 scoring for RCTs was used. The rationale for all selected studies is in the supplementary information. The GRADE certainty assessment table is also in the supplementary information.

RESULTS

Following the full-text screening, 29 papers were included in this analysis. The ROBINS-I and RoB 2 tools were utilised to evaluate the risk of bias, with specifics provided in (Supplementary Table 1). Studies categorised as having moderate to severe risk (retrospective studies) were considered if they presented complete and significant results. Most RCTs raised concerns about blinding, particularly concerning the assessment of results, yet they were included because of their review value.

The bias risk across studies was reassessed through domain-specific evaluations. Overall and domain-specific bias assessments are presented above. The GRADE analysis determined the certainty of evidence for key outcomes (Table 1). Pain scores and healing time were rated as of low certainty due to bias and inconsistency issues. Dressing frequency received a 'Very low' certainty rating due to smaller sample sizes and greater variability. These evaluations highlight the need for more rigorous trials (Figure 2).

Although many studies were identified and included in the systematic review, only a subset was used in the quantitative meta-analysis. This decision was based on the availability and completeness of extractable statistical data required for pooled analysis. Specifically, studies had to report outcomes in a form that allowed for calculating effect sizes — namely, the provision of mean values, standard deviations (or errors), and sample sizes for both intervention and control groups.

Multiple studies, including those on polymer dressings, reported results either narratively or in non-standard formats (such as medians without dispersion metrics) and often lacked appropriate direct comparators for meta-analysis. Although other types, such as economic evaluations or studies focusing on surrogate endpoints (such as satisfaction scores), hold value, they were excluded from aggregation because of methodological differences.

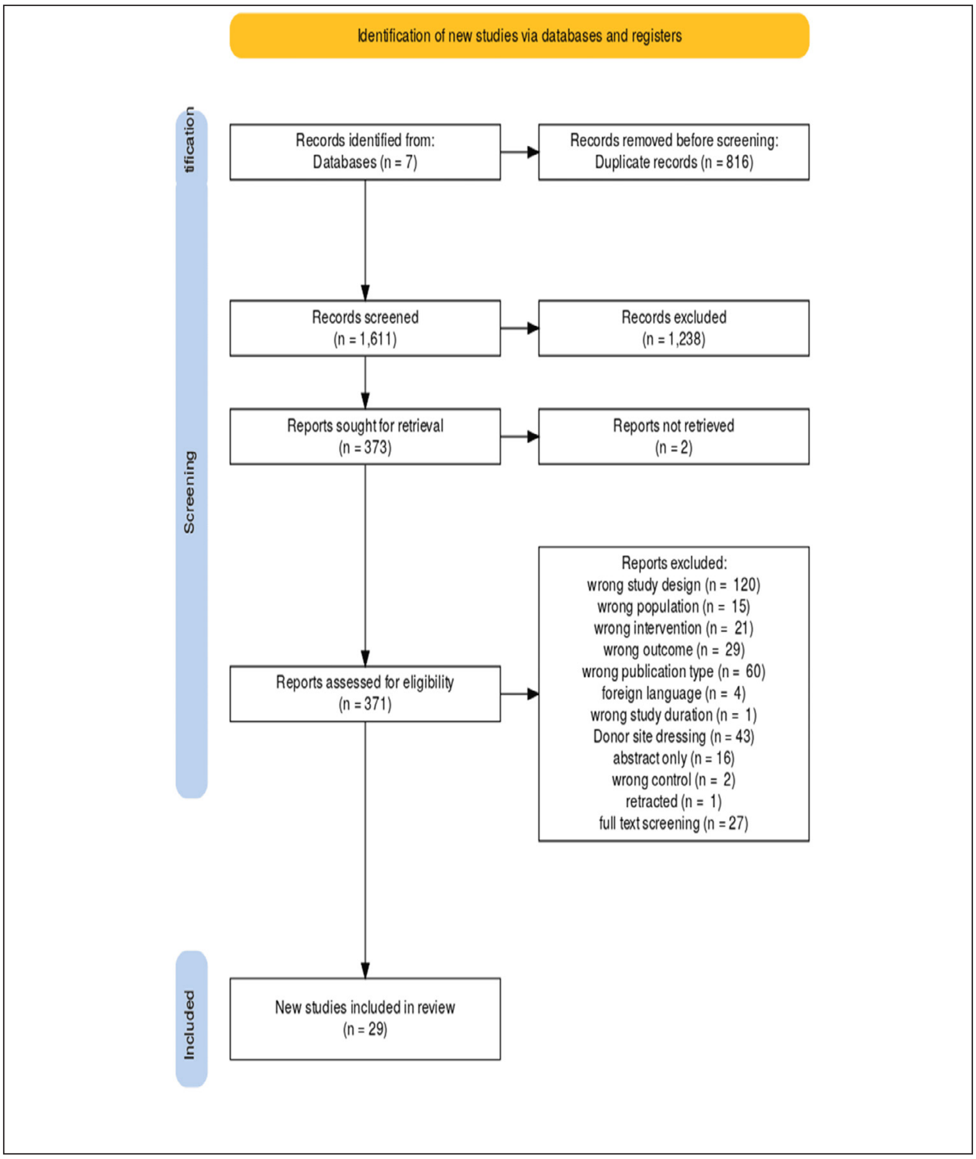

Figure 1: PRISMA flowchart for included studies

Table 1: GRADE certainty assessment.

Outcome	No. of studies	Certainty (initial)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Final certainty
Pain score	7	High	Downgrade (some unclear blinding)	Downgrade (moderate heterogeneity)	No downgrade	No downgrade	Downgrade (possible small-study effects)	Low
Healing time	5	High	Downgrade (blinding, attrition)	Downgrade (I^2>75%)	No downgrade	No downgrade	Possible	Low
Dressing frequency	4	High	Downgrade (reporting bias)	Downgrade (varied protocols)	Downgrade (some indirect cost proxies)	Downgrade (small N)	Possible	Very low

The final meta-analytic sample was limited to studies reporting pain scores or healing times in a statistically analysable format and using well-matched comparator groups (such as, SSD or another polymer dressing). This approach ensured methodological rigour and minimised bias in the pooled estimates. A funnel plot was created to assess potential publication bias.

Group A: Silver dressings: Tang et al (2015)[16] conducted a randomised controlled trial comparing silver-impregnated polymer dressings (Mepilex Ag) with standard 1% SSD ointment dressings. Healing rates were comparable (p=0.558), but the polymer dressing showed quicker healing in the first week (44.3% healed versus 27.0%, p=0.0092). The polymer dressing also significantly reduced pain (VAS 0–100) (6.78 at 4 weeks, P=0.0081, 11.7 at week 1, p<0.001 versus 11.0 at 4 weeks and 23.9 at week 1). Mepilex Ag resulted in fewer dressing changes per patient (3.04 versus 14) and yielded greater satisfaction among patients and nursing staff (p<0.001).[16] This trend aligns with Silverstein et al's (2011)[17] study, which shows similar healing rates and duration for Mepilex Ag compared to 1% SSD, but with lower pain scores and fewer dressing changes. Mepilex Ag was associated with reduced total treatment expenses ($395 versus $776) due to fewer dressing changes and shorter hospital stays.[17] These studies show Mepilex Ag is more efficient than traditional dressings. Aquacel Ag is a popular silver dressing made of sodium carboxymethylcellulose infused with 1.2% silver ions. It swells on contact with burn wound exudates, releasing silver ions that promote an aseptic environment.[18] Aquacel Ag was compared to 1% SSD, medicated paraffin gauze, petroleum gel gauze, and another silver polymer dressing (Acticoat Ag), which has three layers: an absorbent layer, silver-impregnated polyurethane mesh, and an outer layer of rayon polyester.[18]

Compared to a 1% SSD dressing, Aqualcel Ag significantly reduced pain and dressing change frequency (p<0.02). Healing rates were similar: 10±3 and 4.23±1.53 days (Aquacel) versus 13±3 and 10.34±7.52 days (1% SSD), p<0.02. Although Aqualcel's cost was higher than traditional dressings, fewer changes and lower analgesic use resulted in a lower total cost of treatment.[19-21] A similar trend was seen compared to medicated paraffin gauze (Jelonet) and petroleum jelly gauze.[22-24]

Compared with Acticoat, Aquacel excelled across all metrics and showed comparable healing results rates.[18, 25] Aquacel is more economical than Acticoat.[26] Compared to 1% SSD, Acticoat showed no significant difference in treatment outcome but was more expensive than the standard dressing.[26]

Askina Calgitrol Ag®, a calcium alginate dressing infused with silver ions, demonstrated quicker healing times, fewer required dressing changes, and a notable decrease in pain scores upon application compared to 1% SSD.[27] Other dressings mentioned in (Table 2) are promising.[29-31]

Group B (Non-Silver Dressings): Primary dressings discussed in this section are bacterial-cellulose dressings, nanocellulose dressings, collagen-based dressings, chitosan dressings, and Suprathel (synthetic, a copolymer comprising polylactide and trimethylene carbonate ε-caprolactone)[32], and Biobrane (a semi-permeable silicone membrane is bonded to a nylon mesh fabric, which is complemented by a layer of collagen derived from porcine skin)[33] (Table 2).

Bacterial cellulose-based dressings are gaining popularity because they have a natural porous structure, excellent biocompatibility, and maintain a moist wound environment. Since bacterial strains produce them, they can be

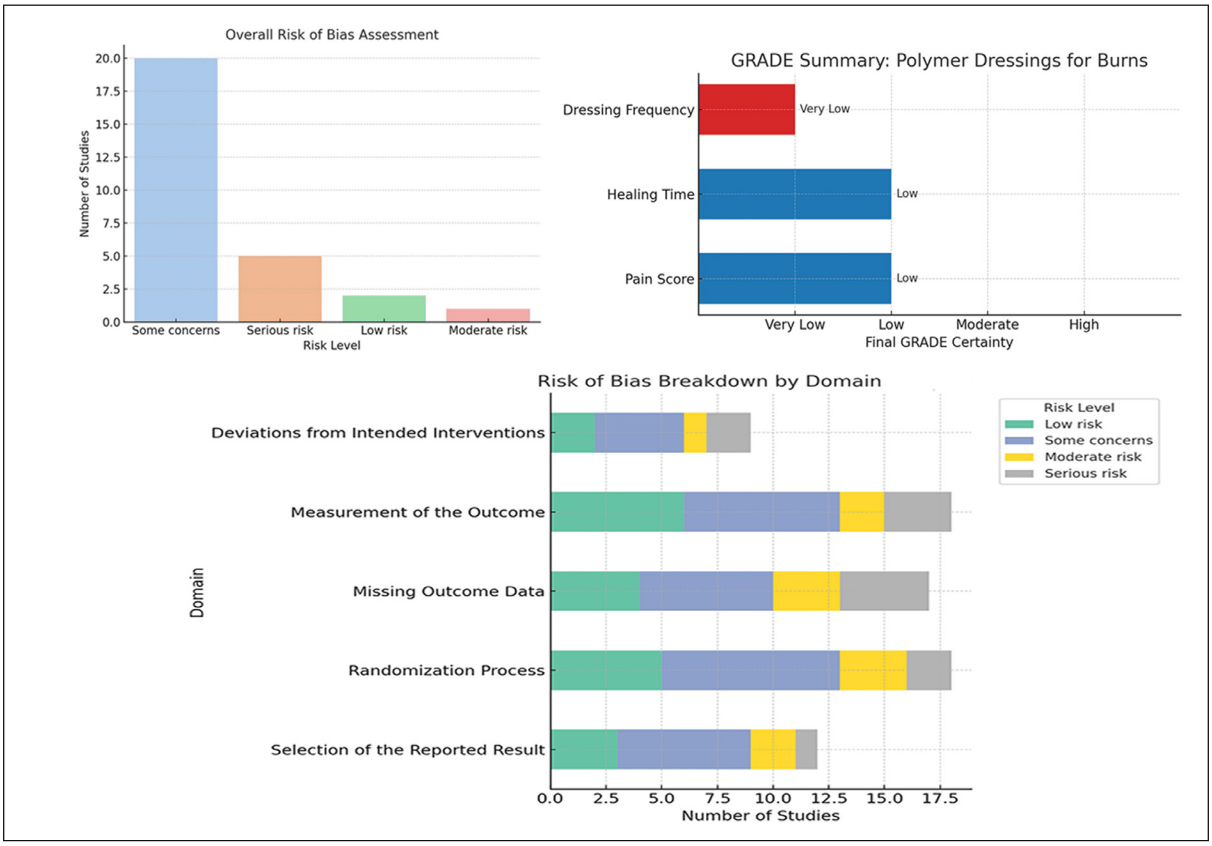

Figure 2: Overall risk of bias, GRADE Certainty assessment and Domain Specific Risk of bias assessment.

Table 2: This table contains the results of the subgroups analysed in this systematic review. Comparing Silver based polymer dressings and non-silver-based polymer dressings to conventional treatments and comparison of multiple polymer dressings together.

Authors (year) references	Dressings	Type of burn	Healing time or rate	Pain scores	Number of dressing changes	Cost effectiveness
Tang et al (2015), Silverstein et al (2011)[16,17]	Mepilex Ag ® versus 1% SSD	Superficial partial-thickness burns TBSA 2–5%	Comparable: p>0.05	Significant reduction: p<0.001, p<0.05	2–3/ patient versus 12–14/ patient: p<0.001	$395 (344–450) versus $776 (659–892)
Caruso et al (2006), Muangman et al (2010), Shipra et al (2024) [19-21]	Aquacel® Ag versus 1% SSD	Superficial partial-thickness burns TBSA 5–20%	Comparable: p>0.05, except Shipra et al p<0.05	Significant reduction: p<0.001	3–7/ patient versus 13–19/ patient: p<0.05	$1409.06 versus $1967.95 (treatment cost), $52±29 versus $93±36 (average dressing cost)
Lau et al (2016), Saba et al (2009), Cebeci & Acaroğlu (2019) [22-24]	Aquacel Ag® versus (paraffin gauze /+topical antibiotics, Petrolatum gauze + bacitracin)	Superficial partial-thickness burns TBSA 5–20%	Faster healing: p=0.045, p=0.005	Significant reduction: p=0.01	3–6/ patient versus 17–20/ patient: p<0.001	$5936 (6 dressings; 14-day stay) versus $9912 (20 dressings; 23-day stay), lower analgesic use
Brown et al (2016), Verbelen et al (2014) [18,25]	Aquacel® Ag versus Acticoat™	Superficial partial-thickness burns TBSA 2–5%	Comparable: p=0.5	Significant reduction: p=0.006	1–5/ patient versus 2–24/ patient: p<0.05	Average treatment cost 4814 euros versus 13,249 euros
Moreira et al (2022),[26] Peters & Verchere (2006)[30]	Nanocrystalline silver dressing (Acticoat Flex 3®/ Anticoat) versus 1% SSD	Superficial partial-thickness burns TBSA 2–5%	Comparable: p=0.5	Comparable: p=0.5	Comparable: p=0.5	I$ 496.37±445.90 versus I$ 274.73±182.76 (Anticoat more expensive)
Opasanon et al (2010)[27]	Askina Calgitrol Ag® versus 1% SSD	Superficial partial-thickness burns TBSA 5–20%	Faster healing: p<0.05	Significant reduction: p<0.02	2–3/ patient versus 5–8/ patient: p<0.06	NA
Ye et al (2025)[28]	Hyperbranched polyamide-Ag dressing (HBPs-Ag dressing) versus silver-impregnated tulle dressing (Atrauman Ag)	Superficial partial-thickness burns TBSA 5–20%	Comparable: P=0.5	Comparable: P=0.5	Comparable: P=0.5	NA
Jester et al (2008)[29]	Urgotul SSD®(Silver sulfadiazine-impregnated tulle) versus Contreet® Ag (Silver foam dressing)	Superficial partial-thickness burns TBSA 2–5%	Comparable: P=0.5	Comparable: P=0.5	NA	NA
Piatkowski et al (2011), Aboelnaga et al (2018)[35-37]	Bio-cellulose dressing with polyhexanide (BWD + PHMB) compared to silver sulfadiazine (SSD) cream; microbial cellulose dressing versus silver sulfadiazine (SSD) cream	Superficial partial-thickness burns TBSA 5–20%	Comparable NS: P>0.05	Significantly lower: P<0.001	Fewer dressing changes 0.4 per day versus 1 per day (1 (1–2) versus 9.65 (6–16) total dressings: P<0.001	70.61 euros versus 165.81 euros per patient

Authors (year) references	Dressings	Type of burn	Healing time or rate	Pain scores	Number of dressing changes	Cost effectiveness
Maurer et al (2022), Renkert et al (2024)[37-39]	BNC (epicite® hydro) nanocellulose polymer/bacterial nanocellulose versus PU foam	Superficial partial-thickness burns TBSA 5–10%	Comparable: p>0.05, not significant	Less anaesthesia with BNC; pain scores 0.59±0.91 (BNC group) versus 1.54±1.13 (PU-foam), not significant	Number of changes, inpatient setting=1.09± 0.68 (BNC group) versus 1.62±1.08 (PU-foam), not significant	NA
Schiefer et al (2021)[39]	Bacterial nanocellulose (BNC) epicite hydro compared to Suprathel	Superficial partial-thickness burns TBSA 5–10%	Mean 16.1±4.8 versus 15.4±4.9 days: p>0.05, not significant	Comparable: p>0.05	Comparable: p>0.05	Comparable
Pan et al (2022)[40]	Bacterial cellulose (BC) dressing versus Vaseline gauze	Superficial partial-thickness burns TBSA 5–20%	8.12±2.15 days versus 10.55±4.40 days, p=0.029	1.86±1.06 v 2.15±1.00 p=0.225	3.47±1.29 per patient versus 3.55±1.35 per patient	Higher cost (small-scale production)
Gurugubelli et al (2023)[41]	Biopolymer sheet from bovine collagen versus. standard gauze + saline	Partial-thickness burns <20% TBSA	7.7 (2.56) versus 10.3(4.2) days: p=0.008	4 ±1.48 versus 6.4±1.8 p<0.001	Less than 4 dressings, p<0.001	Cost-effectiveness in 70% of cases
Gerding et al (1990)[42]	Biobrane versus SSD	Partial-thickness burns <5% TBSA	10.6±0.8 days versus 15.0±1.2 days: p<0.01, significant	1.6±0.8 versus 3.6±1.3: p<0.001 significant	NA	$434±14 versus $504±24: p<0.05, significant
Hu et al (2023)[4]	Chitosan dressing versus moist wound dressing	Partial-thickness 2nd degree burns	19.53±2.74 days versus 24.78±4.86 days, p=0.016	4.57±0.85 versus 4.62±0.76; p=0.544	NA	$1258.7±223.6 versus $1248.9±182.3: t=1.571, p=0.071
Schwarze et al (2008)[44]	Suprathel® (biosynthetic membrane) versus. Omiderm (hydrophilic polyurethane)	Superficial and mid-dermal partial-thickness burns	10.5 versus 12.7 days, p> 0.05	Lower: p=0.0072	Fewer dressing changes: p<0.001	Higher $2 per sq cm versus $0.10 per sq cm
Shang et al (2021), Wang et al (2021), Celik and Akelma (2023)[46-48]	Hydrogel dressing versus Vaseline gauze	2nd degree partial-thickness burns	10.11 versus 13.17 days: p<0.001, 17:15±3:18 versus 20:63±4:43: p<0.001	2:38±0:54 v 4:62±1:25 p<0.001	4.2±1.5 versus 7.4±1.9, t=-11.986 and p<0.01	NA
Erring et al (2019)[49]	Silver nanoparticle gel versus Nano-silver foam versus Collagen fibre dressing with silver (PPAF-Ag)	Partial-thickness burns TBSA 15–40%	8.2 (foam) versus 10.1 (gel) versus 12.5 (collagen): p<0.05	Lowest in foam silver-foam group by day 5 (p=0.038). This difference remained significantly lower in the SF group at day 10: p=0.002	Similar cost	Silver Foam outperformed gel and collagen sheets, as clinicians' Likert scale ratings indicated significant improvement (SG: 78%, C: 80%, SF: 95%, p = 0.011). Dressing change times were significantly shorter in the SF group by day 14: p<0.001

Authors (year) references	Dressings	Type of burn	Healing time or rate	Pain scores	Number of dressing changes	Cost effectiveness
Aggarwala et al (2021)[50]	Biobrane® v Acticoat® v Mepilex® Ag v Aquacel® Ag	Partial-thickness burns TBSA 15–40%	Biobrane 10.8±2.4, Mepilex Ag 8.9± 2.4, Anticoat Ag 9.6±3.3, Aquacell Ag 9.6±3.2: p=0.06	Biobrane 3.39, Mepilex Ag 2.32, Anticoat Ag 2.02, Aquacell Ag 2.83: p=0.0551. Similar	Mepilex cheapest	Based on bootstrapping probabilities, Mepilex ® Ag was the dominant intervention (less expensive and more effective) compared to Biobrane™ and Acticoat™
Gee Kee et al (2017)[51]	Acticoat™ v Acticoat + Mepitel®(Silicone dressing) v Mepilex® Ag	Partial-thickness burns <10% TBSA	Mepilex AgTM proved to be the most effective dressing for re-epithelialisation days. ActicoatTM and ActicoatTM used with MepitelTM had a 40% (p<0.01) and 33% (p<0.01) increase in the time until re-epithelialisation, respectively	NA	Cost per patient (AUD): Mepilex $877, Anticoat $1214, Anticoat + Mepitel $1054: p<0.01	The Mepilex AgTM Dressing was the dominant intervention in the primary and sensitivity analyses due to its lower cost and higher effectiveness

Unless otherwise specified, costs are reported in USD (United States Dollars).

manufactured in large quantities at a commercial advantage, making them a favourable option for patients with certain religious beliefs.[34]

When bacterial cellulose dressings were compared with 1% SSD dressings, they showed comparable healing to traditional dressings, but a significant improvement in pain scores and fewer dressing changes were required.[36-36] This reduced the overall treatment cost for the patients. Epicite Hydro (BNC dressing) performed similarly to a simple PU foam dressing for pediatric burn injuries.[37-38] The BNC dressing showed a lower pain score and a faster healing time. However, it performed similarly to Vaseline gauze dressings, except for a little faster initial healing time (p=0.02). Therefore, ultimately, the quicker healing time was deemed insignificant. It also proved more expensive. Moreover, compared to a co-polymer dressing (Suprathel), their performance was similar, highlighting that it can be a reliable alternative to traditional or polymer dressings.[38-40]

When collagen-based dressings were compared to standard treatment options, they showed a significantly accelerated rate of healing, lower pain scores, and fewer dressing changes.[41-42] Hue et al (2023)[4] compared chitosan-based dressings along with wet compress dressings alone.[4-43] Chitosan dressings significantly decreased the healing time (p=0.016) while not affecting the total cost of the treatment, proving their potential benefits in acute burn care. Suprathel, a widely available polymer dressing, is an excellent choice but more expensive than Mepilex Ag or Omiderm.[44-45] Hydrogel dressings have also shown pain relief and required fewer dressing changes, with comparable healing time to standard treatment.[46-48]

Group C (Multiple dressings): Polymer dressings may match or surpass traditional dressings in specific areas; however, it remains unclear which polymer dressing provides the most significant overall economic advantages. Table 2 compares various dressings, revealing that Mepilex Ag (Nano-silver foam) is the most cost-effective and efficient dressing option.[49-51] Although the healing rate, pain scores and number of dressings required were like those of other polymer dressings, Mepilex Ag was the most cost-effective dressing.[49-51]

Meta-analysis results: This section presents meta-analytic findings grouped by comparator types: (1) polymer versus SSD, (2) polymer versus paraffin/Vaseline gauze, and (3) polymer versus polymer. (Table 3) Each group includes a summary table of selected studies, pooled standardised mean differences (SMDS), and forest plots for pain scores and healing times where applicable.

Pain scores analysis: Three subgroup meta-analyses compared pain scores: polymer versus SSD: pooled SMD=-0.61 [95% CI: -0.99, -0.22] I^2=34.5% (moderate heterogeneity); polymer versus paraffin/Vaseline gauze: Pooled SMD=-0.96 [95% CI: -1.21, -0.70] (Figure 3).

Two studies (Table 3) directly compared different polymer dressings (Table 3).[49-50] polymer versus polymer: Pooled SMD=-0.71 [95% CI: -0.79, -0.63] (Appears consistent, limited heterogeneity) (Figure 3). Silver Foam (SF) was assessed against Silver Gel (SG), while Mepilex Ag was evaluated against Biobrane. The pooled effect sizes indicate that Silver Foam/ Mepilex Ag achieved lower pain scores than other polymer options. All findings favour polymer dressings, showing significant decreases in pain scores.

Healing time analysis: Five studies (Table 3) evaluated the healing times of polymer dressings compared to SSD. The combined standardised mean difference (SMD) for healing time was -1.05 [95% CI: -1.38, -0.71], I^2=62.2% (substantial heterogeneity), indicating that polymer-based materials significantly enhance the speed of wound healing.

Funnel plot: The funnel plot (Figure 3) illustrating pain scores in comparing Polymer and SSD with traditional dressings appears generally symmetrical; (Figure 3) however, some asymmetry is present, as smaller studies (for example Tang et al (2015) and Lau et al (2016).[16, 22]

DISCUSSION

This systematic review and meta-analysis evaluate polymer-based dressings for partial-thickness wounds and burns. The results show that these dressings are superior in pain management, healing time, dressing change frequency, and cost-effectiveness compared to traditional options like silver sulfadiazine (SSD) and paraffin gauze.

Pain control was the most improved outcome. Meta-analysis showed significant pain score reductions with polymer dressings versus SSD (SMD=-0.61), paraffin gauze (SMD=-0.96), and other polymers (SMD=-0.71). This supports Tang et al (2015)[16] and Silverstein et al's (2011)[17] findings of significant pain relief with Mepilex Ag. Multiple studies indicated that Aquacel Ag provided better pain control than paraffin gauze and SSD. Meanwhile, Askina Calgitrol Ag and bacterial cellulose dressings consistently outperformed SSD in reducing pain intensity.

The pooled data indicate that polymer dressings significantly reduced healing time compared to SSD (SMD=-1.05). Individual trials found that Aquacel Ag[22] and Calgitrol Ag[26], respectively, led to quicker re-epithelialisation, while additional studies demonstrated accelerated healing with bacterial cellulose and chitosan hydrogel dressings.[41,44]

Across studies, dressing change frequency was significantly lower in polymer groups. Mepilex Ag required just 2–3 changes per patient, whereas SSD required 12–14 changes.[16] Aquacel Ag demonstrated similarly positive outcomes across several trials. Fewer dressing changes enhance patient comfort, alleviate clinical workload, and minimise the risk of secondary infection. Regarding costs, although products like Mepilex Ag and Aquacel Ag had higher unit prices, they proved to be more cost-effective overall. Mepilex Ag led

Table 3: Studies selected for meta-analysis.

Group	Study	Outcome	Comparator
Polymer versus SSD	Tang et al (2015)[16]	Pain score	SSD
Polymer versus SSD	Silverstein et al (2011)[17]	Healing time	SSD
Polymer versus SSD	Wang et al (2011)[47]	Pain score	SSD
Polymer versus SSD	Aggarwala et al (2020)[52]	Pain score	SSD
Polymer versus Paraffin gauze	Lau et al (2016)[22]	Pain score	Paraffin gauze
Polymer versus Vaseline gauze	Pan et al (2022)[40]	Pain score	Vaseline gauze
Polymer versus silver gel	Erring et al (2019)[49]	Pain score	Silver gel
Polymer versus Biobrane	Aggarwala et al (2020)[50]	Pain score	Biobrane

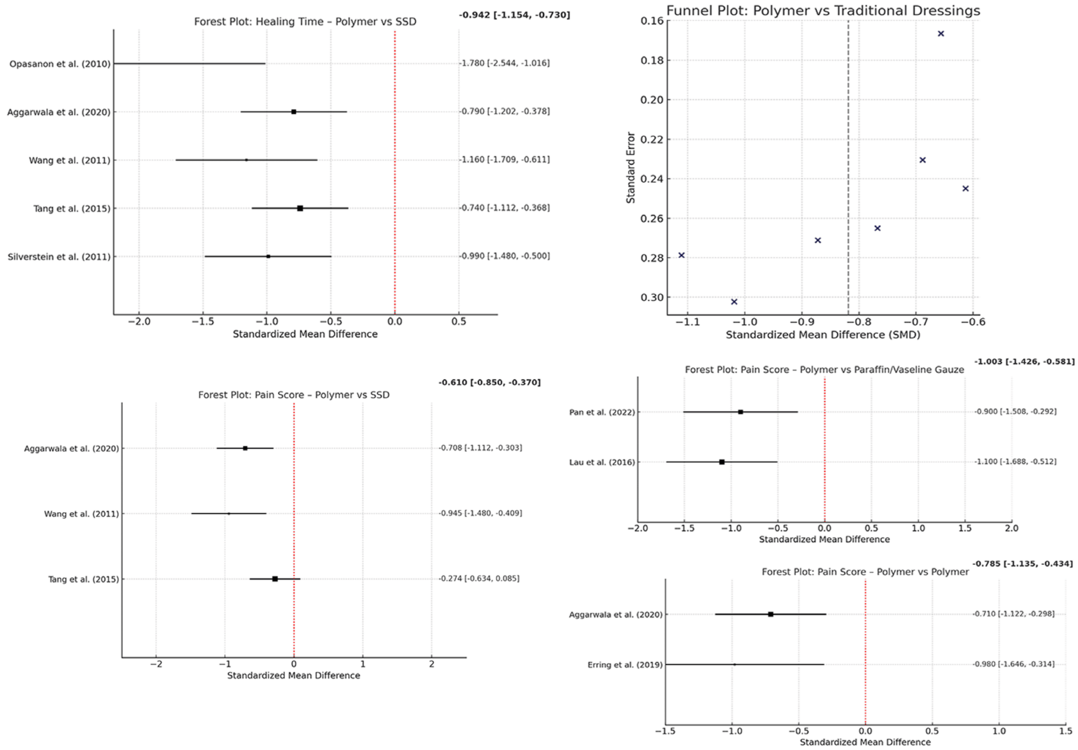

Figure 3: Forest plots for pain score, pain scores: polymer dressings versus SSD; polymer dressings v ersus Paraffin gauze/ Vaseline gauze; Polymer versus polymer. Healing time: Polymer dressings versus SSD; Funnel plot for pain scores polymer dressings versus traditional dressings (SSD and Vaseline/paraffin gauze).

to notably reduced total treatment expenses due to fewer dressing changes and shorter hospital stays.[16] Comparable trends were observed with Aquacel Ag in other studies.[23, 25]

Studies show variability in dressings, protocols, and burn depths; however, Mepilex Ag consistently outperformed in pain, frequency, and cost metrics. Positive results were also noted with Aquacel Ag, bacterial cellulose, and Calgitrol Ag. In contrast, dressings like Suprathel and Acticoat showed more variable effectiveness depending on context. The expanded funnel plot of seven studies displayed a roughly symmetrical distribution with some remaining asymmetry. Smaller trials with positive results suggest potential small-study effects or publication bias.[16, 22]

Larger effect sizes suggest polymer dressings, indicating potential small-study effects or selective reporting. Variation in comparators complicates results, as differing control treatments may distort the funnel's shape. The analysis cannot identify publication bias, given there were only seven studies. While no clear evidence of significant bias exists, the risk of reporting bias and small-study effects remains.

LIMITATIONS

First, only a subset of relevant studies provided extractable quantitative data, limiting the trials in meta-analyses. Essential studies were excluded due to missing standard deviations or unclear group sizes. Second, clinical heterogeneity across dressings, comparators and burn severity complicates comparisons and weakens pooled estimate precision. Additionally, there was limited data to compare silver-based dressing to others like cellulose, chitosan, and Suprathel. Third, evidence quality varied: some RCTs were robust, while others had unclear blinding or allocation concealment. Blinding was often impractical, increasing performance and detection bias chances. Lastly, some outcomes (such as cost) were inconsistently reported, making meta-analysis difficult. Low grade certainty reflects heterogeneity in study design, outcome reporting, and follow-up duration across included trials.

CONCLUSIONS

From a clinical and economic perspective, polymer-based dressings improve outcomes for treating partial-thickness burns using SSD and paraffin-based methods. Mepilex Ag consistently delivers benefits in pain relief, healing time, cost and user-friendliness. Polymer-based dressings are generally more expensive per unit. Their advantages include faster healing, fewer dressing changes, and improved patient comfort, resulting in reduced hospital stays, labour needs and overall treatment costs. This confirms their cost-effectiveness despite higher unit prices. Also, other than Mepilex and Aquacel Ag, some non-silver dressings, including those made from bacterial cellulose and chitosan, showed similar benefits, particularly regarding patient comfort and dressing tolerance. Nevertheless, direct comparisons between different classes of polymer dressings are still scarce, and the varying methods used in studies make it difficult to interpret the results with certainty.

Although the findings suggest that polymer-based dressings could enhance the quality and efficiency of burn care, the evidence remains inconclusive due to small sample sizes, inconsistent reporting, and variations in study design and outcome measures. These limitations underscore the urgent need for larger, multicentre and standardised trials that compare leading polymer formulations across diverse patient populations and healthcare settings. Given the clinical variability and limited pooled data, these findings should guide rather than dictate clinical decisions. If more studies are conducted properly, it will steer us towards the most optimal dressing choice in the future. This will improve patient care and benefit healthcare all over the globe economically.

CONFLICT OF INTEREST

No potential conflict of interest was reported by the authors.

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