Alginate dressings for treating pressure ulcers (Review)


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Alginate dressings for treating pressure ulcers

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Abstract

Background
Pressure ulcers, also known as bedsores, decubitus ulcers and pressure injuries, are localised areas of injury to the skin or the underlying tissue, or both. Dressings are widely used to treat pressure ulcers and there are many options to choose from including alginate dressings. A clear and current overview of current evidence is required to facilitate decision-making regarding dressing use for the treatment of pressure ulcers. This review is part of a suite of Cochrane reviews investigating the use of dressings in the treatment of pressure ulcers. Each review will focus on a particular dressing type.

Objectives
To assess the effects of alginate dressings for treating pressure ulcers in any care setting.

Search methods
For this review, in April 2015 we searched the following databases the Cochrane Wounds Group Specialised Register; The Cochrane Central Register of Controlled Trials (CENTRAL) (The Cochrane Library); Ovid MEDLINE; Ovid MEDLINE (In-Process & Other Non-Indexed Citations); Ovid EMBASE; and EBSCO CINAHL. There were no restrictions based on language or date of publication.

Selection criteria
Published or unpublished randomised controlled trials (RCTs) comparing the effects of alginate with alternative wound dressings or no dressing in the treatment of pressure ulcers (stage II or above).

Data collection and analysis
Two review authors independently performed study selection, risk of bias assessment and data extraction.

Main results
We included six studies (336 participants) in this review; all studies had two arms. The included studies compared alginate dressings with six other interventions that included: hydrocolloid dressings, silver containing alginate dressings, and radiant heat therapy. Each of the six comparisons included just one study and these had limited participant numbers and short follow-up times. All the evidence was of low or very low quality. Where data were available there was no evidence of a difference between alginate dressings and alternative treatments in terms of complete wound healing or adverse events.
Authors’ conclusions

The relative effects of alginate dressings compared with alternative treatments are unclear. The existing trials are small, of short duration and at risk of bias. Decision makers may wish to consider aspects such as cost of dressings and the wound management properties offered by each dressing type, for example, exudate management.

PLAIN LANGUAGE SUMMARY

Alginate dressings for treating pressure ulcers

What are pressure ulcers, and who is at risk?

Pressure ulcers, also known as bedsores, decubitus ulcers and pressure injuries, are wounds involving the skin and sometimes the tissue that lies underneath. Pressure ulcers can be painful, may become infected, and so affect people’s quality of life. People at risk of developing pressure ulcers include those with spinal cord injuries, and those who are immobile or who have limited mobility - such as elderly people and people who are ill as a result of short-term or long-term medical conditions.

In 2004 the total annual cost of treating pressure ulcers in the UK was estimated as being GBP 1.4 to 2.1 billion, which was equivalent to 4% of the total National Health Service expenditure. People with pressure ulcers have longer stays in hospital, and this increases hospital costs. Figures from the USA for 2006 suggest that half a million hospital stays had ‘pressure ulcer’ noted as a diagnosis; the total hospital costs of these stays was USD 11 billion.

Why use alginate dressings to treat pressure ulcers?

Dressings are one treatment option for pressure ulcers. There are many types of dressings that can be used; these can vary considerably in cost. Alginate dressings are a type that is highly absorbant and so can absorb the fluid (exudate) that is produced by some ulcers.

What we found

In June 2014 we searched for as many relevant studies as we could find that had a robust design (randomised controlled trials) and compared alginate dressings with other treatments for pressure ulcers. We found 6 studies involving a total of 336 participants. Alginate have been compared with hydrocolloid dressings, another type of alginate dressing, dextranomer paste dressing, silver-alginate dressing, silver-zinc sulfadiazine cream and treatment with a radiant heat system in these studies. There was no evidence from these studies to suggest that alginate wound dressings are more effective at healing pressure ulcers than other types of dressings or skin surface (topical) treatments, or other interventions.

Generally, the studies we found did not have many participants and the results were often inconclusive. Some study reports did not provide information about how they were conducted and it was difficult to tell whether the results presented were likely to be true. More research of better quality is needed to find out if alginate dressings are better at healing pressure ulcers than other types of dressings or other treatments. This review is part of a suite of reviews investigating dressings for the treatment of pressure ulcers.

This plain language summary is up-to-date as of June 2014.
**SUMMARY OF FINDINGS FOR THE MAIN COMPARISON**

Comparison 1: Alginate dressing followed by hydrocolloid dressing compared with hydrocolloid dressing alone

**Patient or population:** patients with pressure ulcers  
**Settings:**  
**Intervention:** alginate dressing  
**Comparison:** hydrocolloid dressing

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Illustrative comparative risks* (95% CI)</th>
<th>Relative effect (95% CI)</th>
<th>No of participants (studies)</th>
<th>Quality of the evidence (GRADE)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Assumed risk</td>
<td>Corresponding risk</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydrocolloid dressing</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Change in wound size</strong></td>
<td>The mean reduction in ulcer size (compared to baseline) was 42.5%</td>
<td>The mean reduction in ulcer size (compared to baseline) was 69.1%</td>
<td>n/a</td>
<td>110 (1 study)²³</td>
<td>⊕⊕⊕⊕ very low¹²</td>
</tr>
<tr>
<td></td>
<td>Follow up: mean 8 weeks</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>Wound infection</strong></td>
<td></td>
<td>RR 2.79 (0.12 to 67.10)</td>
<td>110 (1 study)²³</td>
<td></td>
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<tr>
<td>Follow-up: mean 8 weeks</td>
<td></td>
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<tr>
<td><strong>Adverse events</strong></td>
<td>94 per 1000</td>
<td>106 per 1000 (34 to 325)</td>
<td>RR 1.12 (0.36 to 3.44)</td>
<td>110 (1 study)⁴</td>
<td>⊕⊕⊕ low³⁴</td>
</tr>
<tr>
<td>Follow-up: mean 8 weeks</td>
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</table>

*The basis for the assumed risk (e.g. the median control group risk across studies) is provided in footnotes. The corresponding risk (and its 95% confidence interval) is based on the assumed risk in the comparison group and the relative effect of the intervention (and its 95% CI)  
CI: confidence interval; RR: risk ratio
<table>
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<tr>
<th>GRADE Working Group grades of evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High quality:</strong> further research is very unlikely to change our confidence in the estimate of effect</td>
</tr>
<tr>
<td><strong>Moderate quality:</strong> further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate</td>
</tr>
<tr>
<td><strong>Low quality:</strong> further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate</td>
</tr>
<tr>
<td><strong>Very low quality:</strong> we are very uncertain about the estimate</td>
</tr>
</tbody>
</table>

1. Outcome is indirect for ulcer healing
2. Very short follow up time
3. Very wide confidence intervals and low event rate
4. Wide confidence intervals
5. Belmin 2002
**BACKGROUND**

**Description of the condition**

Pressure ulcers, also known as bedsores, decubitus ulcers and pressure injuries, are localised areas of injury to the skin or the underlying tissue, or both. They often occur in areas with a bony prominence such as the sacrum (base of the spine) and the heel (Vanderwee 2007), and are caused by external forces such as pressure, or shear, or a combination of both (EPUAP-NPUAP 2009). Populations at risk of pressure ulceration include those with spinal cord injuries (Gefen 2014), and those immobilised or with limited mobility, such as elderly people and people with acute or chronic conditions that might limit movement or bodily sensation, or both (Allman 1997; Bergstrom 1998; Berlowitz 1990; Berlowitz 1997; Brandeis 1994). Incontinence can also increase risk of ulceration by producing a detrimental environment for the skin (Brandeis 1994). Impaired nutritional status may increase risk as well (Allman 1997; Donini 2005), however, evidence for the effectiveness of nutritional intake interventions for preventing or treating pressure ulcers is currently limited (Langer 2003; Smith 2013).

Normal movements relieve the pressure over bony prominences when people engage in regular, often subconscious, shifts in position when sitting or lying. These movements, that are triggered by a reduction in oxygen levels at pressure points and possible discomfort, distribute pressure from contact at the surface, thus reducing the compression of soft tissue against bone (Gebhardt 2002). People with limited autonomous movement or conditions that dull body sensation, or both (as described above), are at risk of failing to achieve adequate pressure relief. Prolonged exposure of an area of the body to pressure or compression can interrupt the local blood circulation and trigger a cascade of biochemical changes that may lead to tissue damage and ulceration. Immobility can also lead to increased damage from shear and friction, for example, when people are pulled into position in chairs and beds. Pressure ulcers vary in severity. One of the most widely recognised systems for categorising pressure ulcers is that of the National Pressure Ulcer Advisory Panel, which is summarised below (NPUAP 2009).

- **Category/Stage I - non-blanchable erythema:** “Intact skin with non-blanchable redness of a localised area usually over a bony prominence. Darkly pigmented skin may not have visible blanching; its colour may differ from the surrounding area. The area may be painful, firm, soft, warmer or cooler as compared with adjacent tissue. Category I may be difficult to detect in individuals with dark skin tones. May indicate ‘at risk’ persons.”

- **Category/Stage II - partial thickness:** “Partial thickness loss of dermis presenting as a shallow open ulcer with a red pink wound bed, without slough. May also present as an intact or open/ruptured serum-filled or sero-sanguinous filled blister. Presents as a shiny or dry shallow ulcer without slough or bruising (bruising indicates deep tissue injury). This category should not be used to describe skin tears, tape burns, incontinence associated dermatitis, maceration or excoriation.”

- **Category/Stage III - full thickness skin loss:** “Full thickness tissue loss. Subcutaneous fat may be visible but bone, tendon or muscle are not exposed. Slough may be present but does not obscure the depth of tissue loss. May include undermining and tunnelling. The depth of a category/stage III pressure ulcer varies by anatomical location. The bridge of the nose, ear, occiput and malleolus do not have (adipose) subcutaneous tissue and Category/Stage III ulcers can be shallow. In contrast, areas of significant adiposity can develop extremely deep category/stage III pressure ulcers. Bone/tendon is not visible or directly palpable.”

- **Category/Stage IV - full thickness tissue loss:** “Full thickness tissue loss with exposed bone, tendon or muscle. Slough or eschar may be present. Often includes undermining and tunnelling. The depth of a category/stage IV pressure ulcer varies by anatomical location. The bridge of the nose, ear, occiput and malleolus do not have (adipose) subcutaneous tissue and these ulcers can be shallow. Category/Stage IV ulcers can extend into muscle and/or supporting structures (e.g., fascia, tendon or joint capsule) making osteomyelitis or osteitis likely to occur. Exposed bone/muscle is visible or directly palpable.”

Pressure ulcers are relatively common, but complex, wounds. Prevalence estimates vary according to the population assessed, the data collection methods used and decisions made about whether stage I pressure ulcers should be included (as there is no active wound at this stage, but patients are ‘at risk’). A large survey of hospital patients undertaken in several European countries returned a pressure ulcer prevalence (stage II and above) of 10.5% (Vanderwee 2007). In 2009, an estimate for pressure ulcer prevalence (stage II and above) across acute-care, long-term care and rehabilitation settings in the USA was 9.0%, with prevalence highest in long-term acute-care settings (20%) (VanGilder 2009). In the UK, national pressure ulcer data are collected across community and acute settings - although data collection is not yet universal - as part of the National Health Service (NHS) Safety Thermometer initiative (Power 2012). Five per cent of patients across these settings were estimated to have a pressure ulcer in January 2014 (National Safety Thermometer Data 2014). We note that all prevalence figures quoted above are for populations currently receiving medical care. The point prevalence of pressure ulceration in the total adult population was recently estimated in a cross-sectional survey undertaken in Leeds, in the UK. Of the total adult population of 751,485, the point prevalence of pressure ulceration was 0.31 per 1000 (Hall 2014). Pressure ulcer prevalence estimates specifically for community settings have reported rates of 0.77 per 1000 adults in a UK urban area (Stevenson 2013).

Pressure ulcers have a large impact on those affected; they can be painful and may become seriously infected or malodorous. It has
been shown that - after adjustment for age, sex and co-morbidities - people with pressure ulcers have lower health-related quality of life than those without pressure ulcers (Essex 2009). The financial cost of treating ulcers in the UK was recently estimated as between GBP 1214 for a stage I ulcer and GBP 14,108 for a stage IV ulcer (Dealey 2012). In 2004 the total annual cost of treating pressure ulcers in the UK was estimated as GBP 1.4 to 2.1 billion, which was equivalent to 4% of the total NHS expenditure (Bennett 2004). Pressure ulcers have been shown to increase length of hospital stay and associated hospital costs (Allman 1999). Figures from the USA suggest that ‘pressure ulcer’ was noted as a diagnosis for half a million hospital stays in 2006; for adults, the total hospital cost for these stays was USD 11 billion (Russo 2008). Costs to the Australian healthcare system for treating pressure ulceration have been estimated at AUD 285 million per annum (Graves 2005).

**Basic wound contact dressings**

- **Low-adherence dressings and wound contact materials**: these are usually cotton pads that are placed in direct contact with the wound. Examples include paraffin gauze dressing, BP 1993 and Xeroform (Covidien) dressing - a non-adherent petrolatum blend with 3% bismuth tribromophenate on fine mesh gauze. The addition of paraffin and similar substances is largely to stop the dressing from sticking to the wound.

- **Absorbent dressings**: these can be applied directly to the wound or used as secondary absorbent layers in the management of heavily exuding wounds. Examples include Primapore (Smith & Nephew), Mepore (Mölnlycke) and absorbent cotton gauze (BP 1988).

**Advanced wound dressings**

- **Alginate dressings**: these are highly absorbent and come in the form of calcium-alginate or calcium sodium alginate, and they can be combined with collagen. The alginate forms a gel when in contact with the wound surface, which can be lifted off at dressing removal or rinsed away with sterile saline. Bonding to a secondary viscose pad increases absorbency. Examples include Curasorb (Covidien), SeaSorb (Coloplast) and Sorbsan (Unomedical).

- **Foam dressings**: these dressings normally contain hydrophilic polyurethane foam and are designed to absorb wound exudate and maintain a moist wound surface. They are produced in a variety of versions: Some foam dressings include additional absorbent materials, such as viscose and acrylate fibres or particles of superabsorbent polyacrylate; others are silicone-coated for non-traumatic removal. Examples include Allevyn (Smith & Nephew), Biatain (Coloplast) and Tegaderm Foam (3M).

- **Hydrogel dressings**: these consist of cross-linked insoluble polymers (i.e. starch or carboxymethylcellulose) and up to 96% water. They are designed to absorb wound exudate or to rehydrate a wound, depending on wound moisture levels. They are supplied as flat sheets, as an amorphous hydrogel or as beads. Examples include ActiformCool (Activa) and Aquafló (Covidien).

- **Films - permeable film and membrane dressings**: these dressings are permeable to water vapour and oxygen but not to water or micro-organisms. Examples include Tegaderm (3M) and Opsite (Smith & Nephew).

- **Soft polymer dressings**: these dressings are moderately absorbent and are composed of a soft silicone polymer held in a non-adherent layer. Examples include Mepitel (Mölnlycke) and Urgotul (Urgo).

- **Hydrocolloid dressings**: these occlusive dressings are usually composed of a hydrocolloid matrix bonded onto a vapour-permeable film or foam backing. This matrix forms a gel that provides a moist environment when in contact with the

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**Description of the intervention**

Two main strategies are used in the treatment of pressure ulcers, namely, relief of pressure - commonly using specialist support surfaces (McInnes 2011) - alongside management of the wound environment using wound dressings. Other general strategies include providing patient education, managing pain, optimising circulation/perfusion, optimising nutrition, performing surgical wound closure and treating clinical infection (AWMA 2012; EPUAP-NPUAP 2009).

Dressings are widely used in wound care, with the aim of protecting the wound while promoting healing. Classification of dressings usually depends on the key material used in their construction. Several attributes of an ideal wound dressing have been described (e.g. BNF 2013), including:

- the ability of the dressing to absorb and contain exudate without leakage or strike-through;
- lack of particulate contaminants left in the wound by the dressing;
- thermal insulation;
- permeability to water but not to bacteria;
- avoidance of wound trauma on dressing removal;
- frequency with which the dressing needs to be changed;
- provision of pain relief; and
- comfort.

Alginate dressings are the focus of this review; their properties are described below. As alginate dressings are likely to be compared with one of the many alternative wound dressings available, a description of potential comparators, based on the British National Formulary structure (BNF 2013), is also provided. Dressings are listed below by their generic names and, when possible, with examples of corresponding trade names and manufacturers. Dressing names, manufacturers and distributors may vary between countries.
wound surface. Examples include GranuFLEX (ConvaTec) and NU DERM (Systagenix). Fibrous alternatives have been developed that resemble alginates, are not occlusive and are more absorbent than standard hydrocolloid dressings. An example is Aquacel (ConvaTec).

- **Capillary action dressings:** these consist of an absorbent core of hydrophilic fibres held between two low-adherent contact layers. Examples include Advadrain (Advancis) and Vacutex (Protex).
- **Odour absorbent dressings:** these dressings contain charcoal and are used to absorb wound odour, often in conjunction with a secondary dressing to improve absorbency. An example is CarboFLEX (ConvaTec).

**Antimicrobial dressings**

- **Honey-impregnated dressings:** these dressings contain medical-grade honey, which is thought to have antimicrobial and anti-inflammatory properties and can be used for acute or chronic wounds. Examples include Medihoney (Medihoney) and Activon Tulle (Advancis).
- **Iodine-impregnated dressings:** these dressings release free iodine, which is thought to act as a wound antiseptic, when exposed to wound exudate. Examples include Iodoflex (Smith & Nephew) and Iodozyme (Insense).
- **Silver-impregnated dressings:** these dressings are used to treat infected wounds, as silver ions are thought to have antimicrobial properties. Silver versions of most dressing types are available (e.g. silver foam, silver hydrocolloid). Examples include Acticoat (Smith & Nephew) and Urgosorb Silver (Urgo).
- **Other antimicrobial dressings:** these dressings are composed of a gauze or low-adherent dressing impregnated with an ointment thought to have antimicrobial properties. Examples include chlorhexidine gauze dressing (Smith & Nephew) and Cutimed Sorbact (BSN Medical).

**Specialist dressings**

- **Protease-modulating matrix dressings:** these dressings are designed to alter the activity of proteolytic enzymes in chronic wounds. Examples include Promogran (Systagenix) and Sorbion (H & R).

The diversity of dressings available to health professionals (including variations within each type) can make evidence-informed decision making challenging. Furthermore, whilst dressings may be viewed as ‘inert’ and cheap products, increasingly they are being formulated with an ‘active’ ingredient (e.g. silver) or with other antimicrobial products. With increasingly sophisticated technology applied to wound care, practitioners need to know how effective these - often expensive - dressings are compared to more traditional, usually less costly, options. Data on the current use of dressings for the treatment of pressure ulcers are limited, although older studies have shown wide variation in practice and wound (wound type) care knowledge (Pieper 1995).

**How the intervention might work**

Animal experiments conducted over 40 years ago suggest that acute wounds heal more quickly when their surfaces are kept moist rather than left to dry and scab (Winter 1962; Winter 1963a; Winter 1963b). A moist environment is thought to provide optimal conditions for the cells involved in the healing process, as well as allowing autolytic debridement (removal of dead tissue by natural processes), which is thought to be an important part of the healing pathway (Cardinal 2009). The desire to maintain a moist wound environment is a key driver for the use of wound dressings. Wound dressings vary in their level of absorbency, so that a very wet wound can be treated with an absorbent dressing (such as a foam dressing) to draw excess moisture away and avoid skin damage, whilst a drier wound can be treated with a more occlusive dressing to maintain a moist environment. Alginale dressings contain sodium, or sodium and calcium, salts of algic acid. These alginate salts are highly hydrophilic and can absorb large volumes of wound exudate.

**Why it is important to do this review**

Pressure ulcers are a relatively common complex type of wound that have a negative impact on people’s lives and incur high costs for health services. Dressings are widely used as treatment for pressure ulcers, and understanding the existing evidence base and potential uncertainty around the clinical efficacy and cost-effectiveness of different dressing types is important for decision making in this area. An influential international guideline recommends that a dressing which keeps the wound bed moist should be used; this recommendation was classed as level C evidence that is “supported by indirect evidence (e.g., studies in normal human subjects, humans with other types of chronic wounds, animal models) and/or expert opinion” (EPUAP-NPUAP 2009). The same guidelines suggest that alginate dressings are used to treat pressure ulcers in various scenarios, mainly for the treatment of moderately or heavily exuding ulcers, but these recommendations are based on limited evidence (EPUAP-NPUAP 2009). Two notable systematic reviews of treatments for pressure ulcers have included trials of dressings (Reddy 2008; Smith 2013). Reddy 2008 included five trials of alginates in people with pressure ulcers. These studies were included as part of a much larger review that assessed many pressure ulcer treatments. The report stated, “No single dressing was consistently superior to other dressings in the trials of pressure ulcers we examined”; however, because of the breadth of the review, detailed examination of effect estimates and quantification of uncertainty around the alginate trials was diffi-
cult. One included study reported that a calcium-alginate dressing showed statistically significant improvement in pressure ulcer healing compared with dextranomer paste (with healing measured as mean wound surface area reduction per week). The search for trials for inclusion in the Reddy review was conducted in 2008. The more recent review seems to include dressing interventions but does not mention alginites specifically (Smith 2013). We conclude that up-to-date and transparent information on evidence for the use of alginate dressings to treat pressure ulcers is required. This review is part of a suite of Cochrane reviews investigating the use of dressings in the treatment of pressure ulcers. Each review will focus on a particular dressing type. These reviews will be summarised in an overview of reviews that will draw together all existing Cochrane review evidence regarding the use of dressings to treat pressure ulcers.

**OBJECTIVES**

To assess the effects of alginate dressings on pressure ulcer healing in any care setting.

**METHODS**

**Criteria for considering studies for this review**

**Types of studies**

We included published and unpublished randomised controlled trials (RCTs), including cluster RCTs (that could include studies in which multiple wounds on the same participant were treated with the allocated treatment and outcome data were collected and analysed for each wound), irrespective of the language of report. We included RCTs reported only as abstracts when the available data were sufficient for reasonable data extraction either from the abstract itself or from the study authors. We included cross-over trials only if outcome data were available from the end of the first treatment period before the cross-over. We excluded studies that used quasi-randomisation methods.

**Types of participants**

We included studies that recruited adults with a diagnosis of pressure ulcer (stage II or above) managed in any care setting. We excluded studies involving participants with stage I ulcers. We accepted study authors’ definitions of what they classed as stage II or above, unless it was clear that they included wounds with unbroken skin. We included studies that recruited participants with stage II or higher pressure ulcers alongside people with other types of chronic wounds (e.g. leg or foot ulcers, or both) if the results for people with relevant pressure ulcers were presented separately (or were available from the study authors). Similarly, when a trial included both stage I and more advanced stages of pressure ulcers, we included it in the review only if data on the stage II and above ulcers were reported separately or available on request from study authors.

**Types of interventions**

The primary intervention was alginate wound dressings (BNF 2013). We included any RCT in which the use of a specific alginate dressing was the only systematic difference between treatment groups. We anticipated that probable comparisons would include different types of alginate dressings compared with each other; alginate dressings compared with other dressing types; and alginate dressings compared with other interventions (possibly non-dressing treatments, e.g. topical treatments).

**Types of outcome measures**

**Primary outcomes**

The primary outcome for this review was complete wound healing. We note that, because wound healing is a subjective outcome, it can be at high risk of measurement bias when outcome assessment is not blinded. For this review, we regarded the following measures as providing the most relevant and rigorous measures of outcome.

- Time to complete wound healing (correctly analysed using censored data and preferably adjusted for prognostic co-variates such as baseline size). We considered mean or median time to healing without survival analysis as a valid outcome only if reports specified that all wounds healed (i.e. if the trial authors regarded time to healing as a continuous measure, as there is no censoring).
- Proportion of ulcers healed during follow-up (frequency of complete healing).

When both time to healing and proportion of ulcers healed were reported, we planned to present all data in a summary outcome table for reference purposes, but would focus on reporting the ‘best’ healing outcome available. We considered time to healing (correctly analysed) to be the best outcome. We anticipated presenting data for the latest time point available - unless an earlier time point was clearly the primary focus of the study, in which case data from multiple time points were extracted. We accepted authors’ definitions of what constituted a healed wound. When time to healing was analysed as a continuous measure, but it was not clear whether all wounds healed, or when change or rate of change in wound size was reported without adjustment for baseline size, we documented the use of the outcome in the study, but did not plan to summarize or use the data in any meta-analysis.
Secondary outcomes

- Change (and rate of change) in wound size, with adjustment for baseline size (we attempted to contact study authors to request adjusted means when these were not presented). When change or rate of change in wound size was reported without adjustment for baseline size, use of the outcome in the study was documented but not summarised or used in any meta-analysis.
- Health-related quality of life/health status (measured using a standardised generic questionnaire such as EQ-5D (standardised instrument used to measure health outcomes), Short Form (SF)-36, SF-12 or SF-6 or wound-specific questionnaires such as the Cardiff Wound Impact Schedule). We did not include ad hoc measures of quality of life that were not likely to be validated and would not be common to multiple trials.
- Wound infection (we used the definition of infection used by the study authors rather than specifying a definition of infection here).
- Other adverse events, including pain associated with the ulcer or experienced at dressing change (measured using survey/questionnaire/data capture process or visual analogue scale), when a clear method for the collection of adverse event data was provided.
- Resource use (including measurements of resource use, such as mean number of dressing changes, number of nurse visits, length of hospital stay and whether reoperation/intervention was provided).
- Cost (allocated to resource use).
- Wound recurrence.

For all outcomes we reported outcome measures at the latest time point available (assumed to be length of follow-up if not specified) and the time point specified in the methods as being of primary interest (if this was different from latest time point available).

Search methods for identification of studies

Electronic searches

We searched the following electronic databases:

- Cochrane Wounds Group Specialised Register (searched 14 April 2015);
- The Cochrane Central Register of Controlled Trials (CENTRAL; The Cochrane Library 2015, Issue 3);
- The Database of Abstracts of Reviews of Effects (DARE; The Cochrane Library 2014, Issue 2);
- The Health Technology Assessment Database (HTA; The Cochrane Library 2014, Issue 2);
- The NHS Economic Evaluation Database (NHS EED; The Cochrane Library 2014, Issue 2);
- Ovid MEDLINE (1946 to June Week 2 2014);Ovid MEDLINE (In-Process & Other Non-Indexed Citations, 13 April 2015);
- Ovid EMBASE (1974 to 13 April 2015);
- EBSCO CINAHL (1982 to 13 April 2015).

We used the following search strategy in the Cochrane Central Register of Controlled Trials (CENTRAL):

#1 MeSH descriptor: [Occlusive Dressings] explode all trees
#2 MeSH descriptor: [Biological Dressings] explode all trees
#3 MeSH descriptor: [Alginites] explode all trees
#4 MeSH descriptor: [Hydrogels] explode all trees
#5 MeSH descriptor: [Silver] explode all trees
#6 MeSH descriptor: [Silver Sulfadiazine] explode all trees
#7 MeSH descriptor: [Honey] explode all trees
#8 MeSH descriptor: [Bandages, Hydrocolloid] explode all trees
#9 (dressing* or alginate* or hydrogel* or hydrocolloid* or "foam" or “bead” or "film" or "films" or tulle or gauze or non-adherent or "non adherent" or silver* or honey or matrix):ti,ab,kw
#10 #1 or #2 or #3 or #4 or #5 or #6 or #7 or #9
#11 MeSH descriptor: [Pressure Ulcer] explode all trees
#12 (pressure next (ulcer* or sore* or injur*)):ti,ab,kw
#13 (decubitus next (ulcer* or sore*)):ti,ab,kw
#14 ((bed next sore*):ti,ab,kw
#15 #11 or #12 or #13 or #14
#16 #10 and #15

We combined the Ovid MEDLINE search with the Cochrane Highly Sensitive Search Strategy for identifying randomised trials in MEDLINE: sensitivity- and precision-maximising version (2008 revision; Lefebvre 2011). We combined the EMBASE search with the Ovid EMBASE filter developed by the UK Cochrane Centre (Lefebvre 2011). We combined the CINAHL searches with the trial filters developed by the Scottish Intercollegiate Guidelines Network (SIGN 2011). The search strategies for Ovid MEDLINE, Ovid EMBASE and EBSCO CINAHL can be found in Appendix 1. No restrictions with respect to language, date of publication or study setting were applied.

We also searched the following clinical trials registries.

- ClinicalTrials.gov (http://www.clinicaltrials.gov/).
- EU Clinical Trials Register (https://www.clinicaltrialsregister.eu/).

Searching other resources

We contacted corresponding authors of trials and manufacturers and distributors of wound dressings. We searched the US Food and Drug Administration briefing documents used in the licensing of wound dressings. We tried to identify other potentially eligible trials or ancillary publications by searching the reference lists of retrieved included trials, as well as relevant systematic reviews, meta-analyses and health technology assessment reports.
Data collection and analysis

Selection of studies
Independently, two review authors assessed the titles and abstracts of the citations retrieved by the searches for relevance. After this initial assessment, we obtained full-text copies of all studies believed to be potentially relevant. Independently, two review authors checked the full papers for eligibility; disagreements were resolved by discussion, and, when required, the input of a third review author. When the eligibility of a study was unclear, we attempted to contact study authors to ask for clarification. We recorded all reasons for exclusion of studies that we obtained as full copies. We completed a PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow chart to summarise this process (Liberati 2009).

We obtained all relevant publications when studies have been reported more than once. Whilst the study was included only once in the review, all reports were examined to ensure the maximal extraction of relevant data.

Data extraction and management
We extracted and summarised details of the eligible studies. Two review authors extracted data independently and resolved disagreements by discussion, drawing on a third review author when required. When data were missing from reports, we attempted to contact the study authors to obtain this information. When a study with more than two intervention arms was included, data were extracted only from intervention and control groups that meet the eligibility criteria of the review.

We extracted the following data when possible on those trial arms that were relevant to the review.

- Country of origin.
- Type/grade/category of pressure ulcer.
- Location of pressure ulcer.
- Unit of randomisation and analysis (e.g. participant with single wound, participant with multiple wounds).
- Trial design (e.g. parallel, cluster).
- Care setting.
- Number of participants randomly assigned to each trial arm.
- Eligibility criteria and key baseline participant data.
- Details of treatment regimen received by each group.
- Duration of treatment.
- Details of any co-interventions provided.
- Primary and secondary outcome(s) (with definitions).
- Outcome data for primary and secondary outcomes (by group).
- Duration of follow-up.
- Number of withdrawals (by group).
- Publication status of study.
- Source of funding for trial.

Assessment of risk of bias in included studies
Independently, two review authors assessed the included studies that performed individual randomisation using the Cochrane tool for assessing risk of bias (Higgins 2011a). This tool addresses six specific domains: sequence generation, allocation concealment, blinding, incomplete data, selective outcome reporting and other issues (Appendix 2). We assessed blinded outcome assessment and completeness of outcome data for each outcome separately where required. We present the risk of bias assessment using two 'Risk of bias' summary figures; one providing a summary of bias for each item across all studies, and the second providing a cross-tabulation of each trial for all risk of bias items. For trials using cluster randomisation, we assessed the risk of bias using the following domains: recruitment bias, baseline imbalance, loss of clusters, incorrect analysis and comparability with individually randomised trials (Higgins 2011b; Appendix 3).

Measures of treatment effect
For dichotomous outcomes, the risk ratio (RR) was calculated with 95% confidence intervals (CIs). For continuous outcome data, we used the mean difference (MD) with 95% CIs for trials that used the same assessment scale. When trials used different assessment scales, we used the standardised mean difference (SMD) with 95% CIs. Time-to-event data (e.g. time-to-complete wound healing) were reported as hazard ratios (HRs) when possible, in accordance with the methods described in the Cochrane Handbook for Systematic Reviews of Interventions (Deeks 2011). If studies reporting time-to-event data (e.g. time to healing) did not report a hazard ratio, then, when feasible, we planned to estimate this using other reported outcomes, such as numbers of events, through the application of available statistical methods (Tierney 2007).

Unit of analysis issues
Where studies randomised at the participant level and measured outcomes at the wound level, for example for wound healing, and the number of wounds appeared to be equal to the number of participants, we treated the participant as the unit of analysis. We had anticipated a possible unit of analysis issue if individual participants with multiple wounds were randomised, the allocated treatment used on the multiple wounds per participant (or perhaps only on some participants) and then data were presented and analysed by wound not person. This is a type of clustered data and presents a unit of analysis error which inflates precision. In cases where included studies contained some or all clustered data we planned to report this alongside whether data had been (incorrectly) treated as independent. We recorded this as part of the risk of bias assessment. We did not plan to undertake further calculation to adjust for clustering.
Dealing with missing data
It is common to have data missing from trial reports. Excluding participants from the analysis post randomisation or ignoring participants who are lost to follow-up compromises the randomisation and potentially introduces bias into the trial. If it was thought that study authors might be able to provide some missing data, we planned to contact them; however, we anticipated that data would often remain missing because of loss to follow-up. In individual studies, when data on the proportion of ulcers healed were presented, we planned to assume that any randomly assigned participants who were not included in an analysis had an unhealed wound at the end of the follow-up period (i.e. they were considered in the denominator but not in the numerator). When a trial did not specify participant group numbers before dropout, we presented only complete case data.

Assessment of heterogeneity
We considered clinical heterogeneity (i.e. the degree to which RCTs vary in terms of participant, intervention and outcome characteristics) and, where possible, statistical heterogeneity. We assessed statistical heterogeneity using the Chi² test (a significance level of P less than 0.10 was considered to indicate statistically significant heterogeneity) in conjunction with the I² measure (Higgins 2003). I² examines the percentage of total variation across RCTs that is due to heterogeneity rather than to chance (Higgins 2003). We considered that I² values of 40% or less indicated a low level of heterogeneity, and values of 75% or more indicated very high heterogeneity (Higgins 2011c).

Assessment of reporting biases
Reporting biases arise when dissemination of research findings is influenced by the nature and direction of results. Publication bias is one of a number of possible causes of ‘small-study effects’, that is, a tendency for estimates of the intervention effect to be more beneficial in smaller RCTs. funnel plots allow a visual assessment of whether small-study effects may be present in a meta-analysis. A funnel plot is a simple scatter plot of the intervention effect estimates from individual RCTs against some measure of the size or precision of each trial (Sterne 2011). We planned to present funnel plots for meta-analyses comprising 10 or more RCTs using RevMan 5.3.

Data synthesis
Details of included studies were combined in a narrative review according to comparators. In terms of meta-analytical approach, in the presence of clinical heterogeneity (review author judgement) or evidence of statistical heterogeneity, or both, we planned to use the random-effects model. We anticipated using a fixed-effect approach only when clinical heterogeneity was thought to be minimal and statistical heterogeneity was estimated as non-statistically significant for the Chi² value and 0% for the I² assessment (Kontopantelis 2012).

For dichotomous outcomes, we planned to present the summary estimate as a risk ratio (RR) with 95% CI. When continuous outcomes were measured in the same way across studies, we planned to present a pooled mean difference (MD) with 95% CI. We planned to pool standardised mean difference (SMD) estimates when studies had measured the same outcome using different methods. We planned to present pooled data using forest plots. For time-to-event data, we planned to plot (and, if appropriate, pool) estimates of HRs and 95% CIs as presented in the study reports using the generic inverse variance method in RevMan 5.3. Where possible, pooled estimates of treatment effect were obtained by using RevMan (RevMan 2012).

'Summary of findings' tables
We planned to present the main results of the review in ’Summary of findings’ tables. These tables present key information concerning the quality of the evidence, the magnitude of the effects of the interventions examined and the sum of available data for the main outcomes (Schunemann 2011a). The ‘Summary of findings’ tables also include an overall grading of the evidence related to each of the main outcomes using the GRADE (Grades of Recommendation, Assessment, Development and Evaluation) approach. The GRADE approach defines the quality of a body of evidence as the extent to which one can be confident that an estimate of effect or association is close to the true quantity of specific interest. The quality of a body of evidence involves consideration of within-trial risk of bias (methodological quality), directness of evidence, heterogeneity, precision of effect estimates and risk of publication bias (Schunemann 2011b). We planned to present the following outcomes in the ‘Summary of findings’ tables.

- Time to complete ulcer healing when analysed using appropriate survival analysis methods.
- Proportion of ulcers completely healing during the trial period.
- Change in wound area.
- Adverse events.

Subgroup analysis and investigation of heterogeneity
When possible, we planned to perform a subgroup analysis to explore the influence of the following factor on effect sizes.

- Ulcer category: when possible, we anticipated assessing whether there were differences in effect sizes for stage II pressure ulcers and for the more severe stage III and stage IV pressure ulcers.

Sensitivity analysis
When possible, we planned to perform sensitivity analyses to explore the influence of the following factor on effect sizes.
Risk of bias: we planned to assess the influence of removing from meta-analyses studies classed as having high and unclear risk of bias. We would include only studies that were assessed as having low risk of bias in all key domains, namely, adequate generation of the randomisation sequence, adequate allocation concealment and blinding of outcome assessor, for the estimates of treatment effect.

RESULTS

Description of studies
See Characteristics of included studies; Characteristics of excluded studies

Results of the search
The search generated 621 records; we obtained 29 of these records, pertaining to 25 different studies (Figure 1). We are not aware of any relevant on-going studies (registers checked 26 July 2014). We located no new studies by searching reference lists as any relevant studies had been identified in the electronic searching. One study is on-going and this has been detailed here: Characteristics of ongoing studies
Figure 1. Study flow diagram.

621 records screened

592 records excluded

19 full-text articles (for 18 studies) excluded, with reasons

1 study added to on-going studies

29 full-text articles assessed for eligibility

6 studies (with 9 full text articles) included in qualitative synthesis

0 studies included in quantitative synthesis (meta-analysis)
Included studies

This review included six studies (Belmin 2002; Brown-Etris 1997; Chuangsawanich 2013; Meaume 2005; Price 2000; Sayag 1996), which together contained 336 participants. All included studies had two arms. Three studies were conducted in France (Belmin 2002; Meaume 2005; Sayag 1996); one in the USA (Brown-Etris 1997); one in Thailand (Chuangsuwanich 2013), and one in the UK (Price 2000). Five studies had duration of follow up of eight weeks or less and the follow-up time in one study was not clear but was thought to be eight weeks (Brown-Etris 1997; see Table 1):

- four weeks (Meaume 2005);
- six weeks (Price 2000);
- eight weeks (Belmin 2002; Chuangsawanich 2013; Sayag 1996);
- not clear (Brown-Etris 1997).

The following types of alginate dressing were evaluated: calcium-alginate dressings (Belmin 2002; Brown-Etris 1997; Meaume 2005; Sayag 1996); collagen-alginate dressings (Brown-Etris 1997); silver-alginate dressings (Chuangsuwanich 2013; Meaume 2005), and a mixed alginate dressings group (Price 2000; also see Table 1). In this review we consider all non-silver-alginate dressings to be a single group called 'alginate dressings' and silver-containing alginate dressings to be another separate group called 'silver-alginate dressings'. The included studies made the six different treatment comparisons listed below:

- alginate dressing compared with hydrocolloid dressing (Belmin 2002);
- alginate dressing compared with a different alginate dressing (Brown-Etris 1997);
- alginate dressing compared with dextranomer paste dressing (Sayag 1996);
- silver-alginate dressing compared with alginate dressing (Meaume 2005);
- silver-alginate dressing compared with silver-zinc sulfadiazine cream (Chuangsuwanich 2013);
- alginate dressing compared with radiant heat system (Price 2000).

Excluded studies

In total 18 studies were excluded from the review for the following reasons (see Characteristics of excluded studies):

- nine studies did not evaluate an alginate dressing (Bito 2012; Brod 1990; Kurzuk-Howard 1985; Manzanero-Lopez 2004; Meaume 2003; Moody 1993; Oleske 1986; Perez 2000; Torra i Bou 1999);
- two studies did not report a relevant outcome (study authors were contacted where possible to request further information if available; Llewellyn 1996; Hock 1996);
- three studies were not RCTs (Parnell 2005; Saydak 1990; Weheida 1991);
- we could not confirm whether one study was an RCT (Sanchez 2002);
- one study included a mixed wound population and separate pressure ulcer data were not available (Beele 2010);
- the grade of included ulcers was not clear in one study (Trial 2010);
- use of alginate dressing was not the only systematic difference between trial groups in one study (Chirwa 2010).

Risk of bias in included studies

See Figure 2; Figure 3
Figure 2. Risk of bias summary: review authors' judgements about each risk of bias item for each included study.

<table>
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<tr>
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<th>Random sequence generation (selection bias)</th>
<th>Allocation concealment (selection bias)</th>
<th>Blinding of outcome assessment (detection bias)</th>
<th>Incomplete outcome data (attrition bias)</th>
<th>Selective reporting (reporting bias)</th>
<th>Other bias</th>
</tr>
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</table>
Figure 3. Risk of bias graph: review authors’ judgements about each risk of bias item presented as percentages across all included studies.

<table>
<thead>
<tr>
<th>Risk of Bias Item</th>
<th>Low Risk of Bias</th>
<th>Unclear Risk of Bias</th>
<th>High Risk of Bias</th>
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<td>Other bias</td>
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Allocation

Random sequence generation
Two studies were classed as being at low risk of bias for random sequence generation (Meaume 2005; Price 2000). There was appropriate use of computer-generated randomisation schedules in Price 2000, and Meaume 2005 used randomisation lists. The remaining four studies did not provide information about generation of randomisation sequence and were classed as being at unclear risk of bias.

Allocation concealment
We classed one study as being at low risk of bias for this domain as it used sequentially numbered, sealed envelopes (Sayag 1996). All other studies were classed as being at unclear risk of bias for this domain.

Blinding
We judged Chuangsuwanch 2013 and Price 2000 to be at low risk of bias for outcome assessment of reported outcomes relevant to this review. The remaining studies we judged to be at unclear risk of bias.

Incomplete outcome data
We deemed two studies to be at high risk of bias for incomplete outcome data (Brown-Etris 1997; Price 2000). Brown-Etris 1997 presented an interim analysis on 36 participants from a possible 80 enrolled. Price 2000 seemed to have made eight post-randomisation exclusions (58 participants randomised and 50 included in the analysis). The remaining studies we judged to be at low or unclear risk of bias for this domain.

Selective reporting
One study was judged to be at high risk of bias for selective reporting. Brown-Etris 1997 presented limited information in its report but did suggest that time to event data were collected but these were not presented in the study report. We classed the remaining studies as being at low risk of bias based on the reports available for this review. We obtained no protocols.

Other potential sources of bias
Chuangsuwanch 2013 had potential unit of analysis issues as some of the enrolled participants had more than one wound, and it seemed that data were presented at wound level rather than participant level. All other studies were considered to be at low risk of bias for this domain except Brown-Etris 1997, which was deemed to be at unclear risk of bias due to the limited information available.
Effects of interventions

See: Summary of findings for the main comparison Alginate dressing followed by hydrocolloid dressing compared with hydrocolloid dressing alone; Summary of findings 2 Comparison between different alginates; Summary of findings 3 Alginate compared with dextranomer paste; Summary of findings 4 Silver-alginate compared with plain alginate; Summary of findings 5 Alginate compared with radiant heat system
See Table 2 for extracted outcome data.

Comparison 1: alginate dressing followed by hydrocolloid dressing compared with hydrocolloid dressing alone (1 trial; 110 participants)

One study compared use of an alginate dressing for four weeks followed by a hydrocolloid dressing for four weeks with use of a hydrocolloid dressing alone (Belmin 2002). The study had an eight-week follow-up and was classed variously as being at unclear or low risk of bias across the six domains assessed. The study population was people 65 years or older with a pressure ulcer involving subcutaneous tissue and no evidence of wound infection.

Primary outcome: complete wound healing
The Belmin 2002 trial did not report complete wound healing.

Secondary outcome: change in wound size (proportion reduction in area compared with baseline)
Belmin 2002 reported a greater reduction in the mean percentage wound area with the alginate-hydrocolloid (69.1% reduction (standard deviation (SD) 33.9)) in the alginate-hydrocolloid group compared with 42.6% reduction (SD 49.1) in the hydrocolloid: MD 26.50 (95% CI 10.62 to 42.38). Very low quality of evidence due to indirectness of outcome and imprecision.

Secondary outcome: wound infection
There was only one infection reported in the study (no definition of how wound infection was defined was provided) and it is therefore unclear whether there is a difference between these dressing regimens in the risk of infection: RR 2.79 (95% CI 0.12 to 67.10). Very low quality of evidence due to imprecision.

Secondary outcome: adverse events
The study definition of an adverse event included all participants who experienced an adverse event and included the wound infection figures reported above. There was no evidence of a difference in the number of participants with adverse events in the alginate-hydrocolloid group 10.5% (6/57) compared with the hydrocolloid group 9.4% (5/53) although there is high uncertainty (imprecision) around the estimate: RR 1.12 (95% CI 0.36 to 3.44). Low quality of evidence due to imprecision.

Secondary outcomes: resource use
There was on average almost one more dressing removal per week with the alginate-hydrocolloid than the hydrocolloid alone (3.8 removals per week (SD 1.6) in the alginate-hydrocolloid group vs. 2.9 (SD 1.0) in the hydrocolloid group: MD 0.90 (95% CI 0.41 to 1.39).

Secondary outcomes: health-related quality of life, costs, wound recurrence
Not reported.

Summary: alginate-hydrocolloid compared with hydrocolloid alone
Available data reported evidence of a mean percentage reduction in ulcer area over the eight-week period and reduced number of dressing changes favouring treatment with an alginate-hydrocolloid dressing sequence over hydrocolloid alone. There was no evidence of a difference in other outcomes. Low or very low quality of evidence due to indirectness and/or imprecision - Summary of findings for the main comparison.

Comparison 2: comparison between different alginates (1 trial; 36 participants)

One study compared a collagen-alginate dressing with a calcium-alginate dressing in people with pressure ulcers of stage II to IV (Brown-Etris 1997). The duration of follow-up was unclear but may have been eight weeks. The study was classed as being at high risk of attrition bias and reporting bias.

Primary outcome: complete wound healing (proportion of wounds healed)
There was no evidence of a difference in the number of completely healed wounds in groups treated with alternative alginate dressings: 12.5% (3/24) compared with 8.3% (1/12): RR 1.50 (95% CI 0.17 to 12.94). The small size of this study means we cannot be confident that there is no difference. Very low quality of evidence due to risk of bias and imprecision.

Secondary outcomes: adverse events (wound deterioration)
There was no evidence of a difference in the number of wounds that deteriorated (no further details provided) with the different alternative alginate dressings:12.5% with collagen-alginate (3/24)
compared with 25% (3/12) with calcium alginate: RR 0.50 (95% CI 0.12 to 2.12). Again we cannot be confident that there is no difference due to the small sample size. As it was unclear whether participants had multiple wound deterioration events recorded there may be a unit of analysis error. Very low quality of evidence due to risk of bias and imprecision.

Secondary outcomes: change in wound size, health related quality of life, wound infection, resource use, costs, wound recurrence

The Brown-Etris 1997 trial did not report on these outcomes.

Summary: comparison between different alginites

The limited data available suggest no evidence of a difference in the number of pressure ulcers that healed or deteriorated when treated with alternative alginate dressings. The quality of evidence was very low - Summary of findings 2.

Comparison 3: alginate compared with dextranomer paste (1 trial; 92 participants)

One study compared an alginate dressing with dextranomer paste (Sayag 1996). The study had an eight-week follow-up and was classed as being at low or unclear risk of bias across the domains assessed. The study population had stage III or IV pressure ulcers.

Primary outcome: complete wound healing

Sayag 1996 did not report on complete wound healing.

Secondary outcomes: wound infection

There was no evidence of a difference in the number of wound infections requiring systemic antibiotic treatment with the alginate dressing 4.3% (2/47), compared with the dextranomer paste 4.4% (2/45): RR 0.96 (95% CI 0.14 to 6.51). However, only four participants had wound infections so the estimate is uncertain (i.e. imprecise). Very low quality of evidence due to imprecision.

Secondary outcomes: adverse events

There was no evidence of a difference in the total number of participants having at least one adverse event between the alginate group, 8.0% (4/47) and the dextranomer paste group (22.2%) (10/45): RR 0.38 (95% CI 0.13 to 1.13). Very low quality of evidence due to imprecision.

Secondary outcomes: resource use (mean number of dressing changes per week)

There was no evidence of a difference in the mean number of dressing changes per week between the treatments. The alginate group had a mean of 4.28 (SD 1.49) dressings per week compared with 4.52 (SD 1.42) in the dextranomer group: MD -0.24 (95% CI -0.80 to 0.32).

Secondary outcomes: change in wound size, health-related quality of life, costs, wound recurrence

Sayag 1996 did not report on these outcomes.

Summary: alginate dressing compared with dextranomer paste

The limited data suggest no evidence of a difference in the number of adverse events or mean number of dressing changes between alginate dressings and dextranomer paste. The quality of evidence was very low - Summary of findings 3.

Comparison 4: silver-alginate compared with plain alginate (1 trial, 28 participants)

One study compared a silver-alginate dressing with a plain alginate dressing (Meaume 2005). The study had a short follow-up period of four weeks and all participants had stage III or IV ulcers and at least two symptoms of wound infection.

Primary outcomes: complete wound healing

Meaume 2005 did not report on complete wound healing.

Secondary outcomes: change in wound size (proportional reduction in area compared with baseline)

There was no evidence of a difference in the proportional reduction in wound size between the silver-alginate dressing group (31.6%; SD 38.1), and the alginate group (13.9%; SD 50.3): mean difference 17.70% (95% CI -13.07 to 48.47). There is wide variation around the estimates and the resulting mean difference estimate is imprecise. Very low quality of evidence due to indirectness of outcome and imprecision.

Secondary outcomes: wound infection (modified ASEPSIS index score)

Meaume 2005 used a modified version of the ASEPSIS scoring system to quantify postoperative wound infections. Higher scores were worse, but the cut-point used to define the presence of infection for this modified scale was not reported. The mean mASEPSIS score in the silver-alginate dressing group was 81.8 (SD 45.1)
and 115.3 (SD 80.2) in the alginate group: mean difference: -33.50, (95% CI -82.71 to 15.71). Very low quality evidence due to imprecision.

Secondary outcomes: adverse events, health-related quality of life, resource use, costs, wound recurrence

Meaume 2005 did not report on these outcomes.

Summary: silver-alginate compared with plain alginate

There was no evidence of a difference in effects on pressure ulcer area or infection over 4 weeks between silver-alginate and plain alginate dressings. Evidence was of very low quality - Summary of findings 4.

Comparison 5: silver-alginate compared with silver-zinc sulfadiazine cream (1 trial, 20 participants)

One study, Chuangsuwanič 2013, compared a silver-alginate dressing with a silver-zinc sulfadiazine cream in people with stage III or IV pressure ulcers. The study recruited a total of 20 participants with 28 wounds and the data appear to be presented at the wound rather than participant level (i.e., a unit of analysis error); for this reason the study was classed as being at high risk of bias.

Primary outcome: complete wound healing

Chuangsuwanich 2013 did not report on complete wound healing.

Secondary outcomes: change in wound size (proportion reduction in wound area)

There was no evidence of a difference between the groups in mean reduction in ulcer area however this comparison is underpowered and a real difference cannot be ruled out. Mean reduction in area was 22.8% (SD 75.0) in the alginate dressing group and 54.6% (SD 39.9) in the radiant heat system group: mean difference -31.80 (95% CI -65.10 to 1.50). Very low quality of evidence due to indirectness of outcome and imprecision.

Secondary outcomes: resource use (mean dressing cost)

The study reported average dressing costs of USD 377 in the silver-alginate dressing group and USD 468 in the silver-zinc sulfadiazine group. The trialists did not report any details of variation around these estimates.

Secondary outcomes: wound infection, adverse events, health-related quality of life, costs, wound recurrence

Chuangsuwanich 2013 did not report on these outcomes.

Summary: silver-alginate dressing compared with silver-zinc sulfadiazine cream

It is unclear whether there is a difference in the effects of silver-alginate dressings and silver-zinc sulfadiazine on change in ulcer area. Data could not be analysed fully so viewed as very low quality.

Comparison 6: alginate compared with radiant heat system (1 study, 50 participants)

Price 2000 compared an alginate dressing with a radiant heat system in people with stage III and IV non-infected pressure ulcers. The study had a six-week follow-up period The study was classed as being at high risk of bias, as it seems that there was post-randomisation exclusion of participants.

Primary outcome: complete wound healing

Price 2000 did not report on complete wound healing.

Secondary outcomes: change in wound size (proportion reduction in wound area)

There was no evidence of a difference between the groups in mean reduction in ulcer area however this comparison is underpowered and a real difference cannot be ruled out. Mean reduction in area was 22.8% (SD 75.0) in the alginate dressing group and 54.6% (SD 39.9) in the radiant heat system group: mean difference -31.80 (95% CI -65.10 to 1.50). Very low quality of evidence due to indirectness of outcome and imprecision.

Secondary outcomes: adverse events (pain - assumed to be wound related)

At six weeks, there was no evidence of a difference in mean pain score between groups. The mean pain score in the alginate dressing group was 17.2 (SD 19.7), and 16.5 (SD 21.4) in the radiant heat group: MD 0.70, (95% CI -10.70 to 12.10). Very low quality of evidence due to imprecision.

Secondary outcomes: wound infection, health-related quality of life, resource use, costs, wound recurrence

Price 2000 did not report these outcomes.

Summary: alginate dressings compared with radiant heat system

It is unclear whether alginate dressings and a radiant heat system have differential effects on change in pressure ulcer area or any other outcome. Evidence was of very low quality - Summary of findings 5.
## ADDITIONAL SUMMARY OF FINDINGS

### Comparison 2: Comparison between different alginates

**Patient or population:** patients with pressure ulcers  
**Settings:**  
**Intervention:** alginate dressings  
**Comparison:** different brand of alginate dressing

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Illustrative comparative risks* (95% CI)</th>
<th>Relative effect (95% CI)</th>
<th>No of participants (studies)</th>
<th>Quality of the evidence (GRADE)</th>
<th>Comments</th>
</tr>
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<tr>
<td></td>
<td>Assumed risk</td>
<td>Corresponding risk</td>
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<td>Different brand of alginate dressing</td>
<td>Alginate dressings</td>
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<tr>
<td><strong>Complete wound healing</strong></td>
<td>Study population</td>
<td>RR 1.50 (0.17 to 12.94)</td>
<td>36</td>
<td>⊗⊗⊗⊗ very low¹,²,³</td>
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<td>125 per 1000 (14 to 1000)</td>
<td>(1 study)²</td>
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<td></td>
<td>Moderate</td>
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<td><strong>Adverse events</strong></td>
<td>Study population</td>
<td>RR 0.50 (0.12 to 2.12)</td>
<td>36</td>
<td>⊗⊗⊗⊗ very low¹,²,³</td>
<td></td>
</tr>
<tr>
<td>Follow-up: mean 8 weeks</td>
<td>250 per 1000</td>
<td>125 per 1000 (30 to 530)</td>
<td>(1 study)²</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Moderate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*The basis for the assumed risk (e.g. the median control group risk across studies) is provided in footnotes. The corresponding risk (and its 95% confidence interval) is based on the assumed risk in the comparison group and the relative effect of the intervention (and its 95% CI).

CI: confidence interval; RR: risk ratio
GRADE Working Group grades of evidence

**High quality:** further research is very unlikely to change our confidence in the estimate of effect

**Moderate quality:** further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate

**Low quality:** further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate

**Very low quality:** we are very uncertain about the estimate

---

1. Estimate informed by just one study that was deemed to be at high risk of bias for attrition and selective reporting bias
2. Short follow-up time
3. Wide confidence intervals - imprecise estimate. Fewer than 100 participants
### Comparison 3: Alginate compared with dextranomer paste

**Patient or population:** patients with pressure ulcers  
**Settings:**  
**Intervention:** alginate dressing  
**Comparison:** dextranomer paste dressing

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Illustrative comparative risks* (95% CI)</th>
<th>Relative effect (95% CI)</th>
<th>No of participants (studies)</th>
<th>Quality of the evidence (GRADE)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Assumed risk</td>
<td>Corresponding risk</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wound infection</td>
<td>Study population</td>
<td></td>
<td>RR 0.96 (0.14 to 6.51)</td>
<td>92 (1 study)&lt;sup&gt;4&lt;/sup&gt;</td>
<td>⊕⊕⊕⊕∗⃝⃝⃝</td>
</tr>
<tr>
<td>Follow-up: mean 8 weeks</td>
<td>Dextranomer paste</td>
<td>44 per 1000 (6 to 289)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Alginate dressing</td>
<td>43 per 1000 (6 to 289)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Moderate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adverse events</td>
<td>Study population</td>
<td></td>
<td>RR 0.38 (0.13 to 1.13)</td>
<td>92 (1 study)&lt;sup&gt;4&lt;/sup&gt;</td>
<td>⊕⊕⊕⊕∗⃝⃝⃝</td>
</tr>
<tr>
<td>Follow-up: mean 8 weeks</td>
<td>Dextranomer paste</td>
<td>222 per 1000 (29 to 251)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Alginate dressing</td>
<td>84 per 1000 (29 to 251)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Moderate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*The basis for the assumed risk (e.g. the median control group risk across studies) is provided in footnotes. The corresponding risk (and its 95% confidence interval) is based on the assumed risk in the comparison group and the relative effect of the intervention (and its 95% CI)  
CI: confidence interval; RR: risk ratio
<table>
<thead>
<tr>
<th>GRADE Working Group grades of evidence</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High quality:</strong> further research is very unlikely to change our confidence in the estimate of effect</td>
<td></td>
</tr>
<tr>
<td><strong>Moderate quality:</strong> further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate</td>
<td></td>
</tr>
<tr>
<td><strong>Low quality:</strong> further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate</td>
<td></td>
</tr>
<tr>
<td><strong>Very low quality:</strong> we are very uncertain about the estimate</td>
<td></td>
</tr>
</tbody>
</table>

1. Short follow-up time
2. Limited number of events and wide confidence intervals - very imprecise estimate. Also fewer than 100 participants
3. Wide confidence intervals and fewer than 100 participants
4. Sayag 1996
## Silver-alginate compared with plain alginate

**Patient or population:** patients with pressure ulcers  
**Settings:**  
**Intervention:** silver-alginate dressing  
**Comparison:** alginate dressing

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Illustrative comparative risks* (95% CI)</th>
<th>Relative effect (95% CI)</th>
<th>No of participants (studies)</th>
<th>Quality of the evidence (GRADE)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Assumed risk</td>
<td>Corresponding risk</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Alginate dressing</td>
<td>silver-alginate dressing</td>
<td>n/a</td>
<td>110 (1 study)³</td>
<td>⊕⊕⊕⊕ very low¹,²</td>
</tr>
<tr>
<td><strong>Change in wound size</strong></td>
<td>Follow up: mean 4 weeks</td>
<td>The mean reduction in ulcer size (compared to baseline) was 13.9%</td>
<td>The mean reduction in ulcer size (compared to baseline) was 31.6% Ulcers in the intervention group had reduced, on average, by 17.7 percentage points more (compared to baseline measure) (-13.07 to 48.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Wound infection</strong></td>
<td>Follow-up: mean 4 weeks</td>
<td>The mean wound infection score in the control groups was 115.3</td>
<td>The mean wound infection score in the intervention groups was 33.50 lower (82.71 lower to 15.71 higher)</td>
<td>28 (1 study)³</td>
<td>⊕⊕⊕⊕ very low²</td>
</tr>
</tbody>
</table>

*The basis for the assumed risk (e.g. the median control group risk across studies) is provided in footnotes. The corresponding risk (and its 95% confidence interval) is based on the assumed risk in the comparison group and the relative effect of the intervention (and its 95% CI)

CI: confidence interval
GRADE Working Group grades of evidence

High quality: further research is very unlikely to change our confidence in the estimate of effect

Moderate quality: further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate

Low quality: further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate

Very low quality: we are very uncertain about the estimate

1 Indirectness of outcome
2 Wide confidence intervals, short follow-up time and fewer than 100 participants. Very imprecise estimate
3 Meaume 2005
Comparison 6: Alginate compared with radiant heat system

**Patient or population:** patients with pressure ulcers  
**Settings:**  
**Intervention:** alginate dressing  
**Comparison:** radiant heat system

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Illustrative comparative risks* (95% CI)</th>
<th>Relative effect (95% CI)</th>
<th>No of Participants (studies)</th>
<th>Quality of the evidence (GRADE)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Assumed risk</td>
<td>Corresponding risk</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Radiant heat system</td>
<td>Alginate dressing</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| **Change in wound size**  | The mean reduction in ulcer size (compared to baseline) was 54.6%                                        | The mean reduction in ulcer size (compared to baseline) was 22.8% Ulcers in the intervention group had reduced, on average, by 31.8 percentage points less (compared to baseline measure) (-65.10 to 1.50) | n/a                          | 110⁵ (1 study) | ⊗⊗⊗⊗  
very low¹,²,³ |
| Follow up: mean 4 weeks   |                                                                                                         |                          |                             |                                |          |
| **Adverse event (pain)**  | The mean adverse event (pain) in the control groups was 21.4                                            | The mean adverse event (pain) in the intervention groups was 0.70 higher (10.70 lower to 12.10 higher) | 50                           | 50 (1 study)⁵ | ⊗⊗⊗⊗  
very low¹,²,⁴ |
| Follow-up: mean 6 weeks   |                                                                                                         |                          |                             |                                |          |

*The basis for the assumed risk (e.g. the median control group risk across studies) is provided in footnotes. The corresponding risk (and its 95% confidence interval) is based on the assumed risk in the comparison group and the relative effect of the intervention (and its 95% CI)

CI: confidence interval
<table>
<thead>
<tr>
<th>GRADE Working Group grades of evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High quality:</strong> further research is very unlikely to change our confidence in the estimate of effect</td>
</tr>
<tr>
<td><strong>Moderate quality:</strong> further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate</td>
</tr>
<tr>
<td><strong>Low quality:</strong> further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate</td>
</tr>
<tr>
<td><strong>Very low quality:</strong> we are very uncertain about the estimate</td>
</tr>
</tbody>
</table>

1. Comparison informed by a single study deemed to be at high risk of attrition bias
2. Short follow-up time
3. Indirectness of outcome
4. Wide confidence intervals - imprecise estimate. Fewer than 100 participants in study
5. Price 2000


**DISCUSSION**

**Summary of main results**

This review includes all available RCT evidence evaluating alginate dressings to treat pressure ulcers and this amounts to six studies with a total of 336 participants. The studies compared alginate dressings with six alternative treatments: a hydrocolloid dressing; another alginate dressing; silver-alginate dressing; dextranomer paste dressing; a silver-zinc sulfadiazine cream and a radiant heat treatment. In two comparisons the alginate dressing assessed was a silver dressing (silver-alginate dressing compared with alginate dressing, and silver-alginate dressing compared with silver-zinc sulfadiazine cream). Overall the body of literature was very limited: each comparison was only informed by one study, each was small and underpowered to detect differential treatment effects, should they exist. We also note that there may be comparisons that are important to decision makers for which trials have not been conducted.

The primary outcome for this review was complete wound healing, though only one included study reported this outcome. Brown-Etris 1997 compared two non silver-alginate dressings and reported the data on proportion of wounds healed. There was no evidence of a difference in the number of ulcers healed between groups. The study was small and underpowered and the GRADE assessment classed the estimate from this evidence as being of very low quality.

In terms of secondary outcomes, change in wound size (adjusted for baseline size) was presented in four studies - all reporting percentage reduction in area compared with baseline (Belmin 2002; Chuangsuwanch 2013; Meaume 2005; Price 2000). Only one study (Belmin 2002), that compared a alginate dressing with a hydrocolloid dressing, reported a statistically significant reduction in ulcer area in the alginate group.

Belmin 2002 also reported a small but statistically significant difference in the mean number of dressing changes in the sequential use of an alginate dressing compared with use of hydrocolloid alone. There was no evidence of a difference in any other secondary outcomes reported including adverse events and wound infection. All GRADE assessments showed that adverse events and wound infection estimates that were presented were of low or very low quality.

**Quality of the evidence**

**Limitations of design and implementation**

RCTs need to be adequately powered so that they are able to detect treatment effects of a specified size if they exist. This means that sample size calculations should be used to help estimate the number of people recruited to a trial. Additionally trials should have an adequate follow-up period so that there is enough time in which important outcome events, such as complete wound healing, can occur. The trials included in this study were all small and their follow-up periods were generally short. This resulted in an evidence base with almost no complete healing data: generally the relevant outcome data that were reported were underpowered and imprecise, with wide confidence intervals.

All studies included study in this review were at a high or unclear risk of bias. In general studies did not follow good practice for conduct and reporting guidelines, for example CONSORT (Schulz 2010). Key areas of good practice are the robust generation of a randomisation sequence, for example one that is computer-generated, robust allocation concealment, for example by use of a telephone randomisation service, and blinded outcome assessment where possible. All this information should be clearly stated in the study report, as all trial authors should anticipate the inclusion of their trials in systematic reviews. Additionally studies should report clearly how they planned to collect adverse event data and how this process was standardised for both treatment arms. In terms of analysis, where possible, data from all participants should be included, that is, an intention-to-treat analysis should be conducted and measures of variation such as the standard deviation or standard error should be presented around measures where appropriate. Steps should be taken as far as is possible while conducting trials to prevent missing data.

Where possible studies should also use validated scales to measure outcomes. The use of unvalidated scales, including those that have been modified in an ad hoc way, can limit the value of collected data, as it can be difficult to interpret and to synthesis across studies.

**Potential biases in the review process**

The review considered as much evidence as it was possible to obtain, including studies that were not published in English-language journals. It is possible that there may be unpublished data that we have not been able to access. There is a potential for publication bias, however, this is likely to be a limited issue in this review given the large number of negative findings that have been published.

**Agreements and disagreements with other studies or reviews**

No other reviews have presented data on alginate dressings as transparently as they are presented here. Our findings do generally agree with the conclusion of a large review that looked at several treatments for pressure ulcers and concluded that “No single dressing was consistently superior to other dressings in the trials of pressure ulcers we examined” (Reddy 2008). In relation to dressings, the recent National Institute of Health and Clinical Effectiveness
(NICE) Pressure Ulcer Guidelines state that “a dressing for adults that promotes a warm, moist wound healing environment to treat grade 2, 3 and 4 pressure ulcers” should be considered (NICE 2014). Also that gauze dressings should not be offered to treat a pressure ulcer in adults. The NICE review includes all studies included here and we included three studies that were not in the NICE guidelines (Brown-Etris 1997; Chuangsawanich 2013; Price 2000).

A U T H O R S’ C O N C L U S I O N S

Implications for practice

A comprehensive review of current evidence did not evidence of differential effects of alginates and alternative wound treatments on the outcomes that matter for pressure ulcers (including healing). Practitioners may therefore elect to consider other characteristics such as costs and symptom management properties when choosing between alternatives.

Implications for research

Currently there is no evidence of a difference in ulcer healing between alginate-dressed ulcers and those treated with the other dressings and the topical treatment that have been evaluated. In terms of dressing choice, any investment in future research must maximise its value to decision-makers. Given the large number of dressing options, the design of future trials should be driven by high priority questions from patients and other decision makers. It is also important for research to ensure that the outcomes that are collected in research studies are those that matter to patients, carers and health professionals. Where trials are conducted, good practice guidelines must be followed in their design, implementation and reporting. Further reviews are being conducted to synthesise evidence regarding the effect of other dressings on the treatment of pressure ulcers. It would then be useful to conduct further evidence synthesis (overviews of reviews, network meta-analysis or both) to aid decision-making about the choice of dressings for pressure ulcers across all dressing options.

A C K N O W L E D G E M E N T S

The review authors are grateful to the following peer reviewers for their time and comments: Elizabeth McInnes, Gill Norman, Gill Worthy and Zena Moore. The review authors would like to acknowledge the contribution of the copy-editors, Dolores Matthews and Elizabeth Royle.

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R E F E R E N C E S

Belmin 2002 [published data only]

Brown-Etris 1997 [published data only]

Chuangsawanich 2013 [published data only]

Meaume 2005 [published data only]

References to studies included in this review

Belmin 2002 [published data only]
References to studies excluded from this review

Beele 2010 (published data only)

Bito 2012 (published data only)

Brod 1990 (published data only)

Chirwa 2010 (published data only)

Hock 1996 (published data only)

Kurzuk-Howard 1985 (published data only)

Llewellyn 1996 (published data only)

Manzanero-Lopez 2004 (published data only)

Meaume 2003 (published data only)

Moody 1993 (published data only)

Oleske 1986 (published data only)

Parnell 2005 (published data only)

Perez 2000 (published data only)

Sanchez 2002 (published data only)

Saydak 1990 (published data only)

Torra i Bou 1999 (published data only)

Trial 2010 (published data only)


Weheida 1991 (published data only)
### References to ongoing studies

**Guillen-Sola 2013** *(published data only)*

### Additional references

**Allman 1997**

**Allman 1999**

**AWMA 2012**

**Bennett 2004**

**Bergstrom 1998**

**Berlowitz 1990**

**Berlowitz 1997**

**BNF 2013**

**Brandeis 1994**

**Cardinal 2009**

**Dealey 2012**

**Deeks 2011**

**Donini 2005**

**EPUAP-NPUAP 2009**

**Essex 2009**

**Gebhardt 2002**

**Gefen 2014**
Gefen A. Tissue changes in patients following spinal cord injury and implications for wheelchair cushions and tissue loading: a literature review. *Ostomy Wound Management* 2014;60:34–45.

**Graves 2005**

**Hahn 2005**

**Hall 2014**
Alginates dressings for treating pressure ulcers (Review)

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Higgins 2003

Higgins 2011a

Higgins 2011b

Higgins 2011c

Kontopantelis 2012

Langer 2003

Lefebvre 2011

Liberati 2009

McInnes 2011

National Safety Thermometer Data 2014


NICE 2014

NPUAP 2009

Pieper 1995

Power 2012

Reddy 2008

RevMan 2012

Russo 2008

Schulz 2010

Schunemann 2011a

Schunemann 2011b
SIGN 2011

Smith 2013

Sterne 2011

Stevenson 2013

Tierney 2007

Vanderwee 2007

VanGilder 2009

Winter 1962

Winter 1963a

Winter 1963b

* Indicates the major publication for the study
### Characteristics of included studies [ordered by study ID]

**Belmin 2002**

| Methods | • A multicentre, parallel, randomised controlled trial of with 110 participants  
• Conducted in France  
• Follow-up was 8 weeks |
|---|---|
| Participants | • Participants were recruited from 20 geriatric hospital wards  
• Inclusion criteria listed: aged 65 years and older; having at least 1 pressure ulcer that passed through the subcutaneous tissue; pressure ulcer must be on sacrum, elsewhere on the pelvic girdle, or on the heel; pressure ulcer must have surface area less than 50 cm² with granulation tissue not covering more than 50% of the ulcer surface; and no evidence of local infection  
• Exclusion criteria listed: serum albumin below 25 g/L, concurrent treatment with radiotherapy, cytotoxic drugs or corticosteroids; or if surgical or palliative care was needed |
| Interventions | • Group A: calcium-alginate dressings (UrgoSorb, Urgo, France) for the first 4 weeks, and then hydrocolloid dressings (Aloplaque HP, Urgo, France) for the next 4 weeks (n = 57)  
• Group B = hydrocolloid dressing (Duoderm E,Convatec-Bristol Myers Squibb) on the target ulcer for 8 weeks (n = 53) |
| Outcomes | Primary outcomes  
• None reported  
Secondary outcomes  
• Change in ulcer area (adjusted)  
• Wound infection  
• Adverse event (local adverse events; pain at dressing removal)  
• Resource use (number of dressing removals per week) |
| Notes | Study confirmed that only 1 ulcer per participant was considered in the study  
Funding source: not reported |

#### Risk of bias

<table>
<thead>
<tr>
<th>Bias</th>
<th>Authors’ judgement</th>
<th>Support for judgement</th>
</tr>
</thead>
</table>
| Random sequence generation (selection bias) | Unclear risk | Quotation: “Each patient was randomized to one of the two treatment strategies. The randomization was balanced by center and by blocks of four patients”  
Comment: not clear how random sequence was generated |
## Belmin 2002

<table>
<thead>
<tr>
<th>Allocation concealment (selection bias)</th>
<th>Unclear risk</th>
<th>Quotation: “Each patient was randomized to one of the two treatment strategies. The randomization was balanced by center and by blocks of four patients” Comment: not clear whether allocation to treatment was concealed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blinding of outcome assessment (detection bias) All outcomes</td>
<td>Unclear risk</td>
<td>Quotation: “For each tracing, the surface area was measured in triplicate by an independent investigator unaware of treatment allocation, using a digitization table and computer program (AutoCAD), and the mean value was included in the analysis” Comment: adequate evidence of blinding out outcome measure for change in area Other outcomes: Quotation: “Because the appearance and use of the hydrocolloid and alginate dressings were very different, it was not possible to conduct the trial under blinded conditions” Comment: personnel not blinded to intervention during study</td>
</tr>
<tr>
<td>Incomplete outcome data (attrition bias) All outcomes</td>
<td>Unclear risk</td>
<td>No direct quotation addressing this aspect Comment: data appear to be presented for all participants</td>
</tr>
<tr>
<td>Selective reporting (reporting bias)</td>
<td>Low risk</td>
<td>Comment: based on the paper only, protocol not obtained</td>
</tr>
<tr>
<td>Other bias</td>
<td>Low risk</td>
<td>No unit of analysis issue confirmed</td>
</tr>
</tbody>
</table>

## Brown-Etris 1997

<table>
<thead>
<tr>
<th>Methods</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>● Prospective, parallel, randomised control trial of 36 participants</td>
<td></td>
</tr>
<tr>
<td>● Conducted in USA</td>
<td></td>
</tr>
<tr>
<td>● Used unequal randomisation (2:1 ratio)</td>
<td></td>
</tr>
<tr>
<td>● Duration of follow-up unclear</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Participants</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>● Participants recruited from 2 centres in the USA</td>
<td></td>
</tr>
<tr>
<td>● Inclusion criteria listed: stage II, III, IV pressure ulcers</td>
<td></td>
</tr>
<tr>
<td>● Exclusion criteria: not specified</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Interventions</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>● Group A: collagen-alginate dressing (Fibracol, Johnson &amp; Johnson; n = 24)</td>
<td></td>
</tr>
<tr>
<td>● Group B: calcium-sodium alginate dressing (Kaltostar Convatec; n = 12)</td>
<td></td>
</tr>
</tbody>
</table>
### Outcomes

<table>
<thead>
<tr>
<th>Primary outcome</th>
<th>Secondary outcomes</th>
</tr>
</thead>
</table>
| • Proportion healed | • Change in area (not adjusted)  
• Adverse events (wound deterioration) |

### Notes

Abstract only. The abstract reported that 116 participants were enrolled and data from 80 participants were 'considered evaluable'. The interim analysis then presented data on 36 participants. Trial progress was not clear from available text. The report stated that the duration of the study was 8 weeks, but it is not clear how long people were followed up for.

Funding source: not reported

### Risk of bias

<table>
<thead>
<tr>
<th>Bias</th>
<th>Authors' judgement</th>
<th>Support for judgement</th>
</tr>
</thead>
</table>
| Random sequence generation (selection bias) | Unclear risk | Quotation: "... participants were stratified before randomization according to pressure ulcer location and size"  
Comment: no indication of how randomisation was achieved |
| Allocation concealment (selection bias) | Unclear risk | Quotation: "... participants were stratified before randomization according to pressure ulcer location and size"  
Comment: no indication of how randomisation was achieved or if allocation was concealed to investigators |
| Blinding of outcome assessment (detection bias)  
All outcomes | Unclear risk | Quotation: “A complete wound assessment, tracing and photography were completed weekly. The dressing change frequency was dependent on exudate level and was recorded”  
Comment: not clear if those assessing wounds were blinded to the intervention. The study was described as open but it is not clear if this related to outcome assessment also |
| Incomplete outcome data (attrition bias)  
All outcomes | High risk | No direct quotation addressing this aspect  
Comment: the abstract reported that 116 participants were enrolled and data from 80 participants were 'considered evaluable'. The interim analysis then presented data on 36 participants. Trial progress was not clear from available text |
### Brown-Etris 1997 (Continued)

<table>
<thead>
<tr>
<th>Selective reporting (reporting bias)</th>
<th>High risk</th>
<th>No direct quotation addressing this aspect Comment: limited information on which to judge, but the abstract notes that time-to-event data were collected and these were not presented. Generally, outcome data from only a selected group of the trial population seem to have been presented</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other bias</td>
<td>Unclear risk</td>
<td>None noted but limited information available</td>
</tr>
</tbody>
</table>

### Chuangsuwanich 2013

<table>
<thead>
<tr>
<th>Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 2-arm RCT</td>
</tr>
<tr>
<td>• Single-centred, undertaken in Thailand</td>
</tr>
<tr>
<td>• Duration of follow-up was maximum of 8 weeks</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 20 participants with 28 wounds</td>
</tr>
<tr>
<td>• Inclusion criteria listed: people suffering from pressure ulcer(s) in the sacral or trochanteric area; pressure ulcers of grades ranging from III to IV according to the NPUAP pressure ulcer staging system; co-operation of the patient or her/his relatives who could complete the consent form and have regular weekly visits according to the study protocol; aged &gt; 20 years</td>
</tr>
<tr>
<td>• Exclusion criteria listed: pressure ulcers with necrotic tissue that could not be managed with adequate debridement; pressure ulcers with clinical evidence of apparent infection, e.g. ulcers surrounded by an advancing, indurated red border, warm or tender, with purulent exudate, or accompanied by a bad odour; patients with a known history of hypersensitivity to any part of the drugs or products used in this study including calcium-alginate, polyurethane foam, or silver derivatives; patients with a known history of hypersensitivity to sulfa derivatives; patients with a history of glucose-6-phosphate dehydrogenase deficiency</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Group A: silver-alginate dressing (Askina Calgitrol Ag; B Braun Hospicare Ltd., Collooney, Co. Sligo, Ireland; n = 10, 15 wounds), changed every 3 days until completion of the study</td>
</tr>
<tr>
<td>• Group B: silver-zinc sulfadiazine cream (prepared in-house; n = 10, 13 wounds), changed once a day with dry gauze placed as an outer dressing</td>
</tr>
<tr>
<td>• Co-intervention: the wounds were debrided as necessary to remove all necrotic tissue</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary outcome</td>
</tr>
<tr>
<td>None reported</td>
</tr>
<tr>
<td>Secondary outcomes</td>
</tr>
<tr>
<td>• Change in wound area (mean % change in wound size at study end; reduction in wound size by subject over time)</td>
</tr>
<tr>
<td>• Cost of treatment (average of overall cost of treatment which included including the dressing change workload, gauze, and silver-zinc cream; debridement cost including the workload, surgical instruments, and procedural charge and the product costs)</td>
</tr>
</tbody>
</table>
**Risk of bias**

<table>
<thead>
<tr>
<th>Bias</th>
<th>Authors’ judgement</th>
<th>Support for judgement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Random sequence generation (selection bias)</td>
<td>Unclear risk</td>
<td>Quotation: “The enrolled patients were randomly divided into two groups by drawing from a sealed envelope for each group.” Comment: method of generation of random schedule reported. It was not clear whether envelopes were sequentially numbered to ensure random sequence was maintained</td>
</tr>
<tr>
<td>Allocation concealment (selection bias)</td>
<td>Unclear risk</td>
<td>No direct quote addressed this aspect Comment: not stated how the allocation was conducted</td>
</tr>
<tr>
<td>Blinding of outcome assessment (detection bias)</td>
<td>Low risk</td>
<td>Quotation: “After the wound was cleansed by nurse, it was examined and scored by an independent operator, plastic surgeon, who was blinded to the dressing protocol. The wound was measured and evaluated for changes in the wound size, grade, tissue characteristics, and amount of exudate. The photography of the wound bed was recorded.” Comment: the process described and an indication of blinding in assessment of the outcomes</td>
</tr>
<tr>
<td>Incomplete outcome data (attrition bias)</td>
<td>Low risk</td>
<td>Comment: clear from the study how many participants withdraw and the reasons. Analysis was performed on 20 of the 22 randomised participants</td>
</tr>
<tr>
<td>Selective reporting (reporting bias)</td>
<td>Low risk</td>
<td>Comment: based on the paper only, protocol not obtained</td>
</tr>
<tr>
<td>Other bias</td>
<td>High risk</td>
<td>Some of enrolled participants had more than one wound - unit of analysis issues</td>
</tr>
</tbody>
</table>
### Meaume 2005

| Methods | 2-arm RCT  
Conducted in France; 13 centres, geriatric departments  
Follow-up was 4 weeks |
|---------|--------------------------------------------------|
| Participants | 99 participants (101 randomised and 2 post-randomisation exclusions), 28 of whom had pressure ulcers and the remaining study population had venous leg ulcers. Only information relevant to the pressure ulcer population are presented  
Relevant inclusion criteria listed: hospitalised adult patients or patients who could be seen every day for 14 days by the investigators; a grade III-IV (NPUAP system) pressure ulcer located on the ischium, sacrum, trochanter or heel; at least 50% of the wound covered in yellow slough, discoloured or friable granulation tissue, pocketing or undermining at the base of the wound or foul odour. Also in the investigator's opinion no clear signs of infection requiring the use of systemic antibiotics or lymphangitis and/or fever present but at least 2 of the following criteria were required: continuous pain; erythema; oedema; heat; moderate to high levels of serous exudate  
Exclusion criteria listed: people who had received systemic antibiotics during the previous 5 days for any reason. Those with a very poor life expectancy or with a clinical condition that might interfere with wound healing. People who had received topical chemical debridement within the previous 7 days |
| Interventions | Group A: silver-releasing hydroalginate dressing (Silvercel; n = 13)  
Group B: calcium-alginate dressing (Algosteril; n = 15) |
| Outcomes | Primary outcome  
Not reported for pressure ulcers specifically  
Secondary outcomes  
Change in wound area (adjusted)  
Wound infection (mASEPSIS index score) |
| Notes | Study randomised those with pressure ulcers and venous leg ulcer. Only data from pressure ulcers are presented  
Funding source: study was funded by a grant from Johnson and Johnson Wound Management |

### Risk of bias

<table>
<thead>
<tr>
<th>Bias</th>
<th>Authors’ judgement</th>
<th>Support for judgement</th>
</tr>
</thead>
</table>
| Random sequence generation (selection bias) | Low risk | Quotation: “Two a priori randomisation lists were prepared and balanced by blocks of six: one list was venous leg ulcers and one list for pressure ulcers (stratification). Each participating centre was provided with at least one block for each type of wound”  
Comment: evidence of appropriate randomisation method |
| Allocation concealment (selection bias) | Unclear risk | Quotation: “Two a priori randomisation lists were prepared and balanced by blocks |

**Alginate dressings for treating pressure ulcers (Review)**

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Meaume 2005  (Continued)

<table>
<thead>
<tr>
<th>Blinding of outcome assessment (detection bias)</th>
<th>Unclear risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>All outcomes</td>
<td></td>
</tr>
</tbody>
</table>

Quote “The mASEPSIS scoring system, a well-validated tool, was developed to quantify postoperative wound infections and evaluate the effectiveness of antibiotics prophylaxis prior to cardiac surgery. The modified ASEPSIS Index prolongs ASEPSIS use over 14 days without changing its scoring rate”

Comment: unclear if investigators using the mASEPSIS scoring system were blinded to intervention.

| Incomplete outcome data (attrition bias)       | Low risk     |
| All outcomes                                   |              |

No direct quotation to inform here: all those with pressure ulcers seem to have been included in an intention-to-treat analysis.

Comment: adequate evidence to award low risk judgement.

| Selective reporting (reporting bias)           | Low risk     |
| All outcomes                                   |              |

Quotation: “The primary endpoint was the mASEPSIS index score obtained in the first two weeks of treatment”

Comment: outcome fully described in results analysis, therefore low risk judgement given.

| Other bias                                     | Low risk     |
| All outcomes                                   |              |

Price 2000

| Methods                                        |              |
| All outcomes                                   |              |

- 2-arm RCT
- Conducted in single UK centre
- 6 weeks follow-up

| Participants                                   |              |
| All outcomes                                   |              |

- 58 participants were randomised - only 50 were included in the analysis
- Inclusion criteria listed: stage III and stage IV dermal non-infected ulcers
- Exclusion criteria listed: those with existing dermatitis, a history of sensitivity to adhesive products, or taking oral corticosteroids

| Interventions                                  |              |
| All outcomes                                   |              |

- Group A: alginate dressing (choice of alginate dressing decided by centres; n = 25)
- Group B: radiant heat system (Warm-up, Augustine Medical Inc, USA; n = 25)
### Outcomes

**Primary outcome**
- Complete wound healing (proportion ulcers healed)

**Secondary outcomes**
- Change in ulcer size (proportion reduction in area relative to baseline; adjusted)
- Adverse events (pain scores)

### Notes

Funding source: not reported

### Risk of bias

<table>
<thead>
<tr>
<th>Bias</th>
<th>Authors’ judgement</th>
<th>Support for judgement</th>
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</thead>
</table>
| Random sequence generation (selection bias) | Low risk           | Quotation: “Randomisation was achieved using a computer-generated list”  
Comment: adequate evidence to award a low risk judgement |
| Allocation concealment (selection bias)   | Unclear risk       | Quotation: “…allocation [was] concealed in opaque envelopes; once a subject was recruited the next envelope was opened”  
Comment: not clear the envelopes were sequential and/or that they were opened by an independent person |
| Blinding of outcome assessment (detection bias) | Low risk           | Quotation: “Subject demographics and detailed medical and wound histories were recorded, and weekly assessments carried out by one of two research nurses who had been blinded to the study treatment, and included: Wound dimensions (length, breadth, depth); acetate tracings; assessment of subjective rating of wound pain, using a visual analogue scale; recording of condition of surrounding skin, using ‘yes/no’ tick boxes to note presence of healthy, fragile, dry, macerated, oedematous, inflamed, or sweating skin.” |
| Incomplete outcome data (attrition bias) | High risk          | Quotation: “Fifty-eight patients were enrolled to ensure that 50 were evaluable for the primary outcomes of the study; evaluable was defined as inclusion up to week 3 of the intervention. Of the eight patients lost, seven had been allocated the experimental group and one to the control group. Three died within two weeks of recruitment, three experienced a general deterioration in their condition within one week,” |
one and asked to withdraw. Apart from the device-related incident (an allergic reaction to the adhesive), no other withdrawal was related heat therapy. Comment: evidence of post-randomisation exclusion

<table>
<thead>
<tr>
<th>Selective reporting (reporting bias)</th>
<th>Low risk</th>
<th>No direct quotations, but all outcomes (healing rates, temperature, skin condition and pain) were fully reported in the results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other bias</td>
<td>Low risk</td>
<td>None noted</td>
</tr>
</tbody>
</table>

### Sayag 1996

### Methods
- 2-arm RCT
- Participants recruited from 20 centres, 17 of which were elderly care centres and 3 of which were dermatology centres
- The study authors are based in France – it seems likely that this is where the study was conducted, but this was not stated explicitly
- Follow-up for a maximum of 8 weeks

### Participants
- 92 participants
- Inclusion criteria listed: 60 years of age or more; being a hospital in-patient for at least 8 weeks; having a Grade III or IV pressure ulcer (Yarkony’s classification) with a surface area between 5 cm² and 100 cm²
- Exclusion criteria listed: patients with ulcers where more than half of the total ulcer area comprised granulation tissue; those who had pressure ulcers covered by necrotic plaques or with active infection. Those suffering with end-stage renal failure, presenting with end-stage arteriopathy of the lower limbs, or being treated with radiotherapy or cytotoxic drugs

### Interventions
- Group A: calcium-alginate dressings (Algosteril; n = 47)
- Group B: dextranomer paste dressing (Debrisan; n = 45)
- In both groups, sterile gauze was applied as a secondary dressing

### Outcomes
- **Primary outcomes**
  - None reported
- **Secondary outcomes**
  - Change in ulcer size (unadjusted - mean change per week)
  - Wound infection (local infection requiring antibiotics)
  - Adverse events (local adverse events)
  - Resource use (mean number of dressing changes per week)

### Notes
- Funding source: study was funded by Les Laboratoires Brothier
### Bias

<table>
<thead>
<tr>
<th>Bias</th>
<th>Authors' judgement</th>
<th>Support for judgement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Random sequence generation (selection bias)</td>
<td>Unclear risk</td>
<td>Quotation: “Six sealed numbered envelopes containing the allocated treatments were given to each centre. Written consent was obtained from the patient or the patient's legal representative (in accordance with French clinical trial legislation) and treatment was then decided by allocating the envelope with the lowest number to each patient entering the study” Comment: evidence of allocation concealment, however not entirely clear how random sequence was generated</td>
</tr>
<tr>
<td>Allocation concealment (selection bias)</td>
<td>Low risk</td>
<td>Quotation: “Six sealed numbered envelopes containing the allocated treatments were given to each centre. Written consent was obtained from the patient or the patient's legal representative (in accordance with French clinical trial legislation) and treatment was then decided by allocating the envelope with the lowest number to each patient entering the study” Comment: evidence of sufficient allocation concealment</td>
</tr>
<tr>
<td>Blinding of outcome assessment (detection bias)</td>
<td>Unclear risk</td>
<td>Quotation: “The study steering committee requested that two independent experts in microbiology undertake a blind assessment of the two laboratory reports for each patient. This comprised a blind review of the bacteriological raw data contained in each report for each patient on days 1 and 15.” Comment: no other information for outcomes reported in this review</td>
</tr>
<tr>
<td>Incomplete outcome data (attrition bias)</td>
<td>Unclear risk</td>
<td>Quotation: &quot;During the eight-week study, treatment was stopped prematurely in 10 out of the 47 patients in the alginate group (21%) and in 22 of the 45 (49%) in the dextranomer group” Comment: it seems that all participants randomised were included in the analysis, although this is not completely clear as numbers of participant for whom data are available were not clearly presented in the results section</td>
</tr>
</tbody>
</table>

---

Sayag 1996 (Continued)
Selective reporting (reporting bias) | Low risk | All outcomes were reported as described in the methodology
---|---|---
Other bias | Low risk | None noted

**Abbreviation**

mASEPSIS: modified ASEPSIS

RCT: randomised controlled trial

**Characteristics of excluded studies [ordered by study ID]**

<table>
<thead>
<tr>
<th>Study</th>
<th>Reason for exclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beele 2010</td>
<td>The study population included a mixed wound population and separate pressure ulcer data were not available</td>
</tr>
<tr>
<td>Bito 2012</td>
<td>The study did not evaluate an alginate dressing</td>
</tr>
<tr>
<td>Brod 1990</td>
<td>The study did not evaluate an alginate dressing</td>
</tr>
<tr>
<td>Chirwa 2010</td>
<td>Use of alginate dressing was not the only systematic difference between trial groups</td>
</tr>
<tr>
<td>Hock 1996</td>
<td>The study did not report a relevant outcome (study authors were contacted where possible to request further information if available)</td>
</tr>
<tr>
<td>Kurzuk-Howard 1985</td>
<td>The study did not evaluate an alginate dressing</td>
</tr>
<tr>
<td>Llewellyn 1996</td>
<td>The study did not report a relevant outcome (study authors were contacted where possible to request further information if available)</td>
</tr>
<tr>
<td>Manzanero-Lopez 2004</td>
<td>The study did not evaluate an alginate dressing</td>
</tr>
<tr>
<td>Meaume 2003</td>
<td>The study did not evaluate an alginate dressing</td>
</tr>
<tr>
<td>Moody 1993</td>
<td>The study did not evaluate an alginate dressing</td>
</tr>
<tr>
<td>Oleske 1986</td>
<td>The study did not evaluate an alginate dressing</td>
</tr>
<tr>
<td>Parnell 2005</td>
<td>The study was not a randomised controlled trial</td>
</tr>
<tr>
<td>Perez 2000</td>
<td>The study did not evaluate an alginate dressing</td>
</tr>
<tr>
<td>Sanchez 2002</td>
<td>Could not confirm whether this was a randomised controlled trial</td>
</tr>
</tbody>
</table>
(Continued)

<table>
<thead>
<tr>
<th>Study</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saydak 1990</td>
<td>The study was not a randomised controlled trial</td>
</tr>
<tr>
<td>Torra i Bou 1999</td>
<td>The study did not evaluate an alginate dressing</td>
</tr>
<tr>
<td>Trial 2010</td>
<td>Grade of included ulcers not clear</td>
</tr>
<tr>
<td>Weheida 1991</td>
<td>The study was not a randomised controlled trial</td>
</tr>
</tbody>
</table>

**Characteristics of ongoing studies**  
*ordered by study ID*

**Guillen-Sola 2013**

<table>
<thead>
<tr>
<th>Trial name or title</th>
<th>A multi-center, randomized, clinical trial comparing adhesive polyurethane foam dressing and adhesive hydrocolloid dressing in patients with grade II pressure ulcers in primary care and nursing homes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methods</td>
<td>Randomised controlled trial</td>
</tr>
<tr>
<td>Participants</td>
<td>Planning to recruit 820 participants from primary health care and home care centres</td>
</tr>
<tr>
<td>Interventions</td>
<td>Adhesive polyurethane foam</td>
</tr>
<tr>
<td>Outcomes</td>
<td>Percentage of wounds healed after 8 weeks</td>
</tr>
<tr>
<td>Starting date</td>
<td>ISRCTN record shows starting date of 30/09/2012 and end date of 30/09/2015</td>
</tr>
<tr>
<td>Contact information</td>
<td>M Guillen-Sola: <a href="mailto:mguillen@ibsalut.caib.es">mguillen@ibsalut.caib.es</a></td>
</tr>
<tr>
<td>Notes</td>
<td></td>
</tr>
</tbody>
</table>
DATA AND ANALYSES

This review has no analyses.

ADDITIONAL TABLES

Table 1. Summary of studies

<table>
<thead>
<tr>
<th>Study ID</th>
<th>Group A</th>
<th>Group B</th>
<th>Group C</th>
<th>Follow-up time</th>
<th>Complete healing</th>
<th>data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belmin 2002</td>
<td>Calcium-alginate dressings (UrgoSorb, Urgo, France) for the first 4 weeks, and then hydrocolloid dressings (Aloplaque HP, Urgo, France) for the next four weeks (n = 57)</td>
<td>Hydrocolloid dressing (Duoderm E, Convatec-Bristol Myers Squibb) on the target ulcer for 8 weeks (n = 53)</td>
<td>n/a</td>
<td>8 weeks</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Brown-Etris 1997</td>
<td>Collagen-alginate dressing (Fibracol, Johnson &amp; Johnson; n = 24)</td>
<td>Calcium-alginate dressing (Kaltostat Convatec; n = 12)</td>
<td>n/a</td>
<td>Not clear</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Chuangsuwanich 2013</td>
<td>Silver-alginate dressing (Askina Calgitrol Ag; B Braun Hospicare Ltd., Collooney, Co. Sligo, Ireland; n = 10, 15 wounds)</td>
<td>Silver-zinc sulfadiazine cream (prepared in-house; n= 10, 13 wounds)</td>
<td>n/a</td>
<td>8 weeks</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Meaume 2005</td>
<td>Silver-alginate dressing (Silvercel; n = 13)</td>
<td>Calcium-alginate dressing (Algosteril; n = 15).</td>
<td>n/a</td>
<td>4 weeks</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Price 2000</td>
<td>Alginate dressing (choice of alginate dressing decided by centres; n = 25)</td>
<td>Radiant heat system (Warm-up, Augustine Medical Inc, USA; n = 25)</td>
<td>n/a</td>
<td>6 weeks</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Sayag 1996</td>
<td>Calcium-alginate dressings (Algosteril; n = 47)</td>
<td>Dextranomer paste dressing (Debrisan; n = 45)</td>
<td>n/a</td>
<td>8 weeks</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Study</td>
<td>Comparison</td>
<td>Length follow-up</td>
<td>Time to healing data</td>
<td>% Ulcer healed</td>
<td>Change in ulcer size</td>
<td>% reduction in area compared with baseline</td>
</tr>
<tr>
<td>----------</td>
<td>-----------------------------------------------------------------------------</td>
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<td>--------------------------------------------</td>
</tr>
</tbody>
</table>
| **Belmin 2002** | **Group A:** calcium-alginate dressings for 4 weeks followed by hydrocolloid for 4 weeks (n = 57)  
**Group B:** hydrocolloid dressings (n = 53) | 8 weeks           | Not reported         | Not reported     | Not reported        | Not reported                               | Group A: 1/57 (1.8%); Group B: 0/53 (0%) | Participants with local adverse event (including infection)  
Group A: 6/57 (10.5%); Group B: 5/53 (9.4%)  
*Paper confirmed this was reported at the participant level*  
Pain at dressing removal**  
Group A: Yes = 31.3%; Group B: Yes = 35.6%  
**Figures are % of removals rather than figures** | Not reported | Not reported | Mean number of dressing removals per week  
Group A: 3.8 (SD 1.6)  
Group B: 2.9 (SD 1.0) | Not reported | Not reported |
### Table 2. Outcome table (Continued)

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td></td>
<td>8 weeks</td>
<td>Not reported</td>
<td></td>
<td>8 weeks</td>
<td>Not reported</td>
<td></td>
<td>4 weeks</td>
<td>Not reported</td>
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<td>4 weeks</td>
<td>Not reported</td>
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<tr>
<td></td>
<td>Proportion healed</td>
<td>Not reported</td>
<td></td>
<td>% reduction in wound area</td>
<td>Not reported</td>
<td></td>
<td>% reduction in area compared with baseline</td>
<td>Not reported</td>
<td></td>
<td>% reduction in area compared with baseline</td>
<td>Not reported</td>
</tr>
<tr>
<td></td>
<td>Group A: fully healed 3/24 (12.5%) ; Group B: 1/12 (8.3%)</td>
<td></td>
<td></td>
<td>Group A: 44.27%; Group B: 51.07%</td>
<td></td>
<td></td>
<td>Adjusted Group</td>
<td>Not reported</td>
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<tr>
<td></td>
<td>Non-adjusted: reduction in wound size</td>
<td>Not reported</td>
<td></td>
<td>Wound deterioration (no further detail)</td>
<td>Not reported</td>
<td></td>
<td>mASEP-SIS index score* (no units)</td>
<td>Not reported</td>
<td></td>
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<tr>
<td></td>
<td>Group A: 17/24 (70.3%) ; Group B 5/12 (41.7%)</td>
<td></td>
<td></td>
<td>Group A: USD 377.17; Group B: USD 467.74 (P value &lt; 0.001)</td>
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<td>Group A 81.8 (SD)</td>
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<td></td>
<td>Not reported</td>
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</tbody>
</table>

* mASEP-SIS: modified algorithm for assessment of pressure ulcer severity and stage.

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Table 2. Outcome table (Continued)

| Price 2000 | Group A: alginate dressing (n = 25) | 6 weeks | Not reported | Not reported | Not reported | Pain scores measured using a visual analogue scale (lower score is better)
|---|---|---|---|---|---|---
| | Group B: radiant heat dressing (n = 25) | | | | | . Group A: 17.2 (SD 19.7); Group B: 16.5 (SD 21.4)
| Sayag 1996 | Group A: calcium-alginate dressings (n = 47) | 8 weeks | Not reported | Not reported | Not reported | Mean number of dressing changes per week: Group A: 4.
| | Group B: extra- | | | | | |
Table 2. Outcome table  (Continued)

<table>
<thead>
<tr>
<th>Group</th>
<th>0.27 cm² (SD 0.27)</th>
<th>2/47 (4.3%)</th>
<th>10/45 (22%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A:</td>
<td></td>
<td>2/45 (4.4%)</td>
<td>10 participants and 15 events</td>
</tr>
<tr>
<td>Group B</td>
<td>4 events</td>
<td>28 (SD 1.49); Group B 4.52 (SD 1.42)</td>
<td></td>
</tr>
</tbody>
</table>

**APPENDICES**

Appendix 1. Searches

**Database: Ovid MEDLINE(R) 1946 to June Week 2 2014 search strategy**

1 exp Bandages/ (19252)
2 exp Alginates/ (7152)
3 exp Hydrogels/ (10269)
4 exp Silver/ (14286)
5 exp Silver Sulfadiazine/ (780)
6 exp Honey/ (2346)
7 (dressing* or pad or pads or gauze or tulle or film or bead or foam* or non-adherent or non adherent or hydrocolloid* or alginat* or hydrogel* or silver* or honey* or matrix).tw. (384187)
8 or/1-7 (403527)
9 exp Pressure Ulcer/ (9730)
10 (pressure adj (ulcer* or sore* or injur*)).tw. (6721)
11 (decubitus adj (ulcer* or sore*)).tw. (1538)
12 (bedsore* or bed sore*).tw. (512)
13 or/9-12 (11789)
14 8 and 13 (1312)
15 randomized controlled trial.pt. (375822)
16 controlled clinical trial.pt. (88506)
17 randomized.ab. (328137)
18 placebo.ab. (146697)
19 clinical trials as topic.sh. (170410)
20 randomly.ab. (194380)
21 trial.ti. (118324)
22 or/15-21 (880230)
23 exp animals/ not humans.sh. (3951750)
24 22 not 23 (809272)
25 14 and 24 (245)
Database: EMBASE 1974 to 2014 June 20 search strategy

1 exp hydrogel dressing/ or exp occlusive dressing/ or exp wound dressing/ (9624)
2 exp hydrogel/ (17690)
3 exp silver/ (26644)
4 exp sulfadiazine silver/ (2989)
5 exp sulfathiazole silver/ (19)
6 exp honey/ (4013)
7 (dressing* or pad or pads or gauze or tulle or film or bead or foam* or non-adherent or non adherent or hydrocolloid* or alginat* or hydrogel* or silver* or honey* or matrix).tw. (514123)
8 exp alginic acid/ (12790)
9 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 (538309)
10 exp decubitus/ (15266)
11 (pressure adj (ulcer* or sore* or injur*)).tw. (8643)
12 (decubitus adj (ulcer* or sore*)).tw. (1865)
13 (bedsore* or bed sore*).tw. (798)
14 10 or 11 or 12 or 13 (17265)
15 9 and 14 (1691)
16 Randomized controlled trials/ (53514)
17 Single-Blind Method/ (18404)
18 Double-Blind Method/ (116267)
19 Crossover Procedure/ (39225)
20 (random$ or factorial$ or crossover$ or cross over$ or cross-over$ or placebo$ or assign$ or allocat$ or volunteer$).ti,ab. (133 7859)
21 (doubl$ adj blind$).ti,ab. (147331)
22 (singl$ adj blind$).ti,ab. (14565)
23 or/16-22 (1406033)
24 exp animals/ or exp invertebrate/ or animal experiment/ or animal model/ or animal tissue/ or animal cell/ or nonhuman/ (20358792)
25 human/ or human cell/ (14828728)
26 and/24-25 (14782050)
27 24 not 26 (5576742)
28 23 not 27 (1214106)
29 15 and 28 (278)

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S26 S13 AND S25
S25 S14 or S15 or S16 or S17 or S18 or S19 or S20 or S21 or S22 or S23 or S24
S24 MH “Quantitative Studies”
S23 TI placebo* or AB placebo*
S22 MH “Placebos”
S21 TI random* allocat* or AB random* allocat*
S20 MH “Random Assignment”
S19 TI randomi?ed control* trial* or AB randomi?ed control* trial*
S18 AB ( singl* or doubl* or trebl* or tripl*) and AB ( blind* or mask*)
S17 TI ( singl* or doubl* or trebl* or tripl*) and TI ( blind* or mask*)
S16 TI clinic* N1 trial* or AB clinic* N1 trial*
S15 PT Clinical trial
S14 MH “Clinical Trials+”
S13 S7 AND S12
S12 S8 OR S9 OR S10 OR S11
S11 TI decubitus or AB decubitus
S10 ( bed sore* or bedsore* ) or AB ( bed sore* or bedsore* )
S9 TI ( pressure ulcer* or pressure sore* ) or AB ( pressure ulcer* or pressure sore* )
Appendix 2. Risk of bias assessment (individually randomised controlled trials)

1. Was the allocation sequence randomly generated?

Low risk of bias
The investigators describe a random component in the sequence generation process, such as referring to a random number table; using a computer random number generator; tossing a coin; shuffling cards or envelopes; throwing dice; drawing of lots.

High risk of bias
The investigators describe a non-random component in the sequence generation process. Usually, the description would involve some systematic, non-random approach, for example, sequence generated by odd or even date of birth; sequence generated by some rule based on date (or day) of admission; sequence generated by some rule based on hospital or clinic record number.

Unclear
Insufficient information about the sequence generation process available to permit a judgement of low or high risk of bias.

2. Was the treatment allocation adequately concealed?

Low risk of bias
Participants and investigators enrolling participants could not foresee assignment because one of the following, or an equivalent method, was used to conceal allocation: central allocation (including telephone, web-based and pharmacy-controlled randomisation); sequentially numbered drug containers of identical appearance; sequentially numbered, opaque, sealed envelopes.

High risk of bias
Participants or investigators enrolling participants could possibly foresee assignments and thus introduce selection bias, such as allocation based on using an open random allocation schedule (e.g. a list of random numbers); assignment envelopes were used without appropriate safeguards (e.g. if envelopes were unsealed or non-opaque or were not sequentially numbered); alternation or rotation; date of birth; case record number; any other explicitly unsealed procedure.

Unclear
Insufficient information to permit judgement of low or high risk of bias. This is usually the case if the method of concealment is not described or is not described in sufficient detail to allow a definitive judgement, for example, if the use of assignment envelopes is described, but it remains unclear whether envelopes were sequentially numbered, opaque and sealed.
3. Blinding (participants, personnel and outcome assessors) - was knowledge of the allocated interventions adequately prevented during the study?

**Low risk of bias**
Any one of the following.
- No blinding, but the review authors judge that the outcome and the outcome measurement are not likely to be influenced by lack of blinding.
- Blinding of participants and key study personnel ensured, and unlikely that the blinding could have been broken.
- Either participants or some key study personnel were not blinded, but outcome assessment was blinded and the non-blinding of others is unlikely to introduce bias.

**High risk of bias**
Any one of the following.
- No blinding or incomplete blinding, and the outcome or outcome measurement is likely to be influenced by lack of blinding.
- Blinding of key study participants and personnel attempted, but likely that the blinding could have been broken.
- Either participants or some key study personnel were not blinded, and the non-blinding of others is likely to introduce bias.

**Unclear**
Either of the following.
- Insufficient information available to permit a judgement of low or high risk of bias.
- The study did not address this outcome.

4. Were incomplete outcome data adequately addressed?

**Low risk of bias**
Any one of the following.
- No missing outcome data.
- Reasons for missing outcome data unlikely to be related to true outcome (for survival data, censoring unlikely to be introducing bias).
- Missing outcome data balanced in numbers across intervention groups, with similar reasons for missing data across groups.
- For dichotomous outcome data, the proportion of missing outcomes compared with observed event risk not enough to have a clinically relevant impact on the intervention effect estimate.
- For continuous outcome data, plausible effect size (difference in means or standardised difference in means) among missing outcomes not enough to have a clinically relevant impact on observed effect size.
- Missing data have been imputed using appropriate methods.

**High risk of bias**
Any one of the following.
- Reason for missing outcome data likely to be related to true outcome, with imbalance in numbers or reasons for missing data across intervention groups.
- For dichotomous outcome data, the proportion of missing outcomes compared with observed event risk enough to induce clinically relevant bias in intervention effect estimate.
- For continuous outcome data, plausible effect size (difference in means or standardised difference in means) among missing outcomes enough to induce clinically relevant bias in observed effect size.
- 'As-treated' analysis done with substantial departure of the intervention received from that assigned at randomisation.
- Potentially inappropriate application of simple imputation.
Unclear
Either of the following.
- Insufficient reporting of attrition/exclusions to permit judgement of low or high risk of bias (e.g. number randomised not stated, no reasons for missing data provided).
- The study did not address this outcome.

5. Are reports of the study free of the suggestion of selective outcome reporting?

Low risk of bias
Either of the following.
- The study protocol is available and all of the study’s prespecified (primary and secondary) outcomes that are of interest in the review have been reported in the prespecified way.
- The study protocol is not available but it is clear that the published reports include all expected outcomes, including those that were prespecified (convincing text of this nature may be uncommon).

High risk of bias
Any one of the following.
- Not all of the study's prespecified primary outcomes have been reported.
- One or more primary outcomes are reported using measurements, analysis methods or subsets of the data (e.g. subscales) that were not prespecified.
- One or more reported primary outcomes were not prespecified (unless clear justification for their reporting is provided, such as an unexpected adverse effect).
- One or more outcomes of interest in the review are reported incompletely so that they cannot be entered in a meta-analysis.
- The study report fails to include results for a key outcome that would be expected to have been reported for such a study.

Unclear
Insufficient information available to permit judgement of low or high risk of bias. It is likely that the majority of studies will fall into this category.

6. Other sources of potential bias

Low risk of bias
The study appears to be free of other sources of bias.

High risk of bias
There is at least one important risk of bias. For example, the study:
- had a potential source of bias related to the specific study design used; or
- has been claimed to have been fraudulent; or
- had some other problem.

Unclear
There may be a risk of bias, but there is either:
- insufficient information to assess whether an important risk of bias exists; or
- insufficient rationale or evidence that an identified problem will introduce bias.
Appendix 3. Risk of bias assessment (cluster randomised controlled trials)

In cluster randomised trials, particular biases to consider include recruitment bias; baseline imbalance; loss of clusters; incorrect analysis; and comparability with individually randomised trials.

- Recruitment bias can occur when individuals are recruited to the trial after the clusters have been randomly assigned, as knowledge of whether each cluster is an ‘intervention’ or ‘control’ cluster could affect the types of participants recruited.

- Cluster randomised trials often randomly assigned all clusters at once, so lack of concealment of an allocation sequence should not usually be an issue. However, because small numbers of clusters are randomly assigned, there is a possibility of chance baseline imbalance between randomly assigned groups, in terms of the clusters or the individuals. Although not a form of bias as such, the risk of baseline differences can be reduced by using stratified or pair-matched randomisation of clusters. Reporting of the baseline comparability of clusters, or statistical adjustment for baseline characteristics, can help reduce concern about the effects of baseline imbalance.

- Occasionally, complete clusters are lost from a trial and have to be omitted from the analysis. Just as for missing outcome data in individually randomised trials, this may lead to bias. In addition, missing outcomes for individuals within clusters may lead to risk of bias in cluster randomised trials.

- Many cluster randomised trials are analysed by incorrect statistical methods, without taking the clustering into account. Such analyses create a ‘unit of analysis error’ and produce overly precise results (the standard error of the estimated intervention effect is too small) and P values that are too small. They do not lead to biased estimates of effect. However, if they remain uncorrected, they will receive too much weight in a meta-analysis.

- In a meta-analysis including both cluster and individually randomised trials, or including cluster randomised trials with different types of clusters, possible differences between the intervention effects estimated need to be considered. For example, in a vaccine trial of infectious diseases, a vaccine applied to all individuals in a community would be expected to be more effective than vaccine applied to only half of the people. Another example is provided by a Cochrane review of hip protectors (Hahn 2005). The cluster trials showed a large positive effect, whereas individually randomised trials did not show clear benefit. One possibility is that there was a ‘herd effect’ in the cluster randomised trials (which were often performed in nursing homes, where compliance with using the protectors may have been enhanced). In general, such ‘contamination’ would lead to underestimates of effect. Thus, if an intervention effect is still demonstrated despite contamination in those trials that were not cluster randomised, a confident conclusion about the presence of an effect can be drawn. However, the size of the effect is likely to be underestimated. Contamination and ‘herd effects’ may be different for different types of clusters.

Contributions of Authors

Jo Dumville developed the review and co-ordinated its development, completed the first draft of the review, co-ordinated edits of subsequent drafts, made an intellectual contribution, approved the final version before submission and is the guarantor of the protocol.

Nikki Stubbs completed the first draft of the review and made an intellectual contribution to and approved the final version of the review before submission.

Samantha Keogh completed the first draft of the review and made an intellectual contribution to and approved the final version of the review before submission.

Rachel Walker completed the first draft of the review and made an intellectual contribution to and approved the final version of the review before submission.

Matthew Fortnam commented on the review draft and approved the final version of the review before submission.

Zhenmi Liu commented on the review draft and approved the final version of the review before submission.

Contributions of the editorial base

Nicky Cullum: advised on methodology, interpretation and content; and edited the review and approved the review for submission.

Sally Bell-Syer: co-ordinated the editorial process; advised on methodology, interpretation and content; and edited the review.

Amanda Briant: ran the searches.
DECLARATIONS OF INTEREST

Jo C Dumville: nothing to declare.

Samantha Keogh: nothing to declare.

Nikki Stubbs has received funding from pharmaceutical companies to support training and education events in the NHS where she works and payments have been received by the author for non product-related educational sessions. These have been unrelated to the subject matter of the systematic review and have never been in support or in pursuit of the promotion of products.

Rachel Walker: is currently employed by the National Health and Medical Research Council’s Centre of Research Excellence in Nursing (NCREN), Griffith University Australia. Skin integrity including pressure ulcers is a research focus of NCREN.

Matthew Fortnam: nothing to declare.

Zhenmi Liu: nothing to declare.

This protocol/review is part of a suite of reviews investigating the use of individual dressing types in the treatment of pressure ulcers. The first review in this suite was developed by co-author Samantha Keogh. The objective of undertaking these reviews is to use them in an overview which draws together all existing Cochrane review evidence regarding the use of dressing treatments for pressure ulcers to guide clinician decision-making.

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- School of Nursing, Midwifery and Social Work. University of Manchester, UK.

External sources

- NIHR Cochrane Programme Grant Project: 13/89/08 - High Priority Cochrane Reviews in Wound Prevention and Treatment, UK.

DIFFERENCES BETWEEN PROTOCOL AND REVIEW

Change in wound size was assessed as an outcome in summary of finding assessment.

Unit of analysis text changed.