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Allergic Contact Dermatitis Induced by Modern Wound Dressings: A Comprehensive Analysis of Risks and Allergenic Components

Kirley Küçük[1] | Julie Van Gysel[2] | Véronique del Marmol[1] | Jonathan M. L. White[1,3]

[1]Department of Dermatology, Hôpital Erasme, Université Libre de Bruxelles, Brussels, Belgium | [2]Department of Immuno-Allergology, CHU Brugmann, Université Libre de Bruxelles, Brussels, Belgium | [3]Ecole de Santé Publique, Université Libre de Bruxelles, Brussels, Belgium

Correspondence: Kirley Küçük (kirleydermato@outlook.fr)

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ABSTRACT

Modern wound dressings have revolutionised wound care, offering optimal healing environments. However, their widespread use has led to a significant increase in allergic reactions, particularly among patients with chronic leg ulcers. The complex chemical compositions of these dressings can trigger allergic responses. This study investigated allergens in wound dressings for leg ulcers. A comprehensive analysis of seventy-three commonly used dressings in Belgium identified prevalent allergenic components across various types. A centralised database was created to catalogue this information. The study found that hydrocolloids and hydrogels are more likely to cause allergies due to substances like, colophony and propyleneglycol respectively. Hydrofibre, alginate and nonadhesive dressings demonstrated lower risks. Carboxymethylcellulose emerged as a frequent allergen. Patch-testing for patients with leg ulcers is recommended to better identify specific allergens. This study helps healthcare professionals select the most suitable dressings, reducing allergy risks and improving wound healing. However, current legislation limits access to the full composition of dressings, hindering the identification of all potential allergens. Overall, this study is a significant step towards understanding and addressing allergy risks associated with wound dressings, improving care for patients with leg ulcers.

1 | Introduction

Modern dressings represent a cornerstone in the advancement of localised therapeutic interventions. They are designed to create an optimal environment for wound healing across various wound types and healing stages. Their aim is to maintain a moist environment, create mechanical protection and thermal insulation, establish a barrier against microbial invasion, reduce the risk of infection, absorb excess wound exudate and microorganisms, promote debridement and minimise trauma to the healing tissue. Innovations in wound care technology are specifically tailoured to enhance the healing process for leg ulcer patients, thereby significantly improving their quality of life. Leg ulcers are chronic, when they last for more than 6 weeks. They represent a significant global health challenge, affecting up to 1.10% of the population worldwide, including 2% of Europeans. The most common underlying pathology is venous insufficiency. Patients with chronic leg ulcers may therefore suffer from endogenous stasis dermatitis, as well as irritant or allergic contact dermatitis.

Abbreviations: Ca, calcium; CMC, carboxymethylcellulose; EDTA, ethylenediaminetetraacetic Acid; EU, European Union; HPMC, hydroxypropyl methylcellulose; KCl, potassium chloride; MVE, microcrystalline cellulose; NA, not applicable; NaCl, sodium chloride; PEG, polyethylene glycol.

Summary

- Contact dermatitis is common in chronic leg ulcer patients, with prolonged exposure to topical treatments increasing sensitization risks.
- Skin barrier disruption, occlusion, and local hypervascularization enhance allergen absorption, with longer ulcer duration and multiple treatments heightening sensitization risk.
- Modern dressings, especially those with complex ingredients are more likely to contain allergens.
- Patch-testing is recommended to identify specific allergens, but the lack of ingredient transparency complicates diagnosis.
- A more comprehensive approach to patch-testing, including standard and customized batteries, is suggested. Greater transparency from manufacturers would improve allergy management.

Irritant contact dermatitis occurs in 80% of contact dermatitis and often precedes allergic contact dermatitis. When a molecule is in direct and prolonged contact with the skin, innate immunity is activated, which can make the molecule an irritant. Any agent can therefore be irritating, and the strength of this irritation depends on a number of factors, such as the nature and concentration of the molecule, the local environment (if there is occlusion or heat) and the state of the epidermal barrier. We can distinguish between acute irritant contact dermatitis occurring a few minutes to a few hours after exposure to the toxic agent, delayed irritant contact dermatitis occurring 8–48 h after exposure to the agent and chronic irritant contact dermatitis following repeated exposure to the agent, causing xerosis, desquamation on an erythematous background and fissures [1].

Allergic contact dermatitis involves both adaptive and innate immunity, corresponding to type IV hypersensitivity according to the Gell and Coombs classification. There are two phases in this delayed hypersensitivity mechanism: a sensitisation phase and an elicitation phase. Sensitisation depends on the potency of the allergen and the permeability of the epidermal barrier. The elicitation phase occurs a few days to weeks after sensitisation. Clinically, the patient presents with eczematous, lichenoid or vesiculobullous lesions [1].

Allergic contact dermatitis may affect up to 82.5% of patients with chronic leg ulcers [2]. There are several contributing factors such as the alteration of the skin barrier and occlusion enhancing the absorption of potentially allergenic molecules, local hypervascularisation leading to an increased influx of lymphocytes and a higher density of Langerhans cells within and around the ulcer. Extended disease duration correlates with a greater number of topical products applied and thereby increases the exposure to a myriad of potentially allergenic molecules. Forty-five to 90% of this patient population have at least one positive patch test, with up to 75% of them showing polysensitisation [2–6].

When delayed healing and/or perilesional eczema occur, patch tests are recommended to detect contact allergy, a frequent complication of chronic leg ulcers [7]. The prevalence of allergens varies from one region to another and from one era to another, leading to variable sensitisation rates across studies. The most recent European study, carried out in 2022 by Rizo-Poteau [2], highlighted prevalent allergens within the European standard battery, listing them in descending order of sensitisation: *myroxylon pereirae* (25.81%), nickel sulphate (21.51%), fragrance mix I and II (20.43%), benzalkonium chloride (18.28%) and carbon mix (17.20%). Valois's study [8] showed up to 20% sensitisation to modern dressings, with 79% deemed clinically relevant. The study's relevance is diminished by the methodology of patch-testing patients with chronic leg ulcers who lack perilesional eczema and by the difficulty of correlating allergens to dressings. It is often difficult to obtain a complete list of dressing components either in the packaging information, online or even by contacting the relevant company directly [6, 9]. This lack of transparency complicates the diagnostic process and potentially can have a deleterious effect on the management of contact dermatitis in patients with chronic leg ulcers.

In the presence of chronic wound inflammation or perilesional eczema, unresponsive to corticosteroid treatment, which consequently delays healing, patch tests should be performed to exclude contact allergy. When sensitisation occurs and the relevance of an allergen is proven, therapeutic options become constrained. The aim of our work was to propose an appropriate and rapid treatment modality for these allergic patients.

2 | Materials and Methods

We obtained a complete list of topical pharmaceutical products available in Belgium from our hospital pharmacy and crossed-checked with the topical pharmaceutical products used at Erasme Hospital. Additionally, we have listed modern dressings used in Belgium for the treatment of chronic wounds. We also conducted an extensive literature search spanning the last two decades to identify allergens and products reported in delayed wound healing. We then listed all the data into a Microsoft Excel (Microsoft Office) spreadsheet, detailing each product. Access to the composition of topical pharmaceutical products and medical devices was facilitated by the readily available information provided online through the Summary of Product Characteristics (SPC). On the other hand, acquiring the composition details of dressings was more difficult, necessitating the compilation from diverse sources, including company websites and product inserts. When companies failed to provide explicit and comprehensive information, we had to rely on alternative, unofficial websites like 'E-pansement' (https://e-pansement.fr), despite the potential bias inherent in such unverified sources. Every entry in the Excel spreadsheet corresponds to a specific product and its composition. We further categorised each product systemically. To facilitate the analysis of the collected data, we developed a personalised programme using Microsoft Access (Microsoft Office). This is a relational database management system equipped with various functionalities such as table and form creation, data insertion, and more. The programming was executed using Visual Basic 6.0, as included in Microsoft Office. Electronic laboratory notebook was not used.

TABLE 1 | Listing of seventy-three modern dressings and their composition.

Products	Categories	Compound (C1)	C2	C3	C4	C5	C6	C7
Algisite M	Alginate	Cellulose	Calcium alginate					
Algosteril	Alginate	Calcium alginate						
Suprasorb A	Alginate	Calcium alginate	Cellulose					
Suprasorb A + Ag	Alginate	Calcium alginate	Silver					
Urgosorb dressing	Alginate	Calcium alginate	Carboxymethyl cellulose					
Biatain alginate	Alginate	Carboxymethyl cellulose	Calcium alginate					
Biatain alginate Ag	Alginate	Silver	Calcium alginate	Carboxymethyl cellulose				
Actisorb silver	Carbon	Carbon	Silver	Nylon				
Promogran dressing	Collagen	Collagen	Cellulose					
Suprasorb C	Collagen	Collagen	Cellulose					
Mesoft compress	Gauze	Viscose	Polyester					
Sterilux compresss	Gauze	Cotton						
Telfa compresss	Gauze	Cotton	Polyester					
Zetuvit hartmann dressing	Gauze	Cellulose	Polypropylene	Polyamide	Viscose			
Honeypatch dressing	Honey dressing	Formaldehyde	Glucose oxydase	Polyurethane	Chestnut honey	Polyester	Proline	Flavonoids
L-Mesitran ointment	Honey dressing	calendula officinalis	Lanolin	Sunflower oil	Cod liver oil	Alpha-tocopherol	Ascorbic acid	Zinc oxide
Hyalo4 silver spray	Hyaluronic	Hyaluronic acid	Silver	Vitamin E	Rice bran oil	Corn starch	Kaolin	Terpineol
Hyalo4 regen	Hyaluronic	Hyaluronic acid	Collagen					

(Continues)

TABLE 1 | (Continued)

Products	Categories	Compound (C1)	C2	C3	C4	C5	C6	C7
Hyalo4 skin gauze	Hyaluronic	Hyaluronic acid	Cotton	Macrogol	Glycerol	Water		
Hyalo4 skin cream	Hyaluronic	Hyaluronic acid	Sorbitol	Sodium dehydroacetate	Methyl parahydroxybenzoate	Propyl parahydroxybenzoate	Glycerol	Wax
Hyalo4 skin gel	Hyaluronic	Hyaluronic acid	Sorbitol	Sodium dehydroacetate	Methyl parahydroxybenzoate	Propyl parahydroxybenzoate	Sodium hydroxide	Polyacrylate
Hyalo4 start	Hyaluronic	Hyaluronic acid	Paraffin	Vaseline	Collagenase			
Hyalo4 control	Hyaluronic	Hyaluronic acid	Silver sulfadiazine	Sodium dehydroacetate	Sorbitol	Wax	Glycerol	Macrogol
Ialuset compress	Hyaluronic	Hyaluronic acid	Macrogol	Glycerol	Water			
Ialuset cream	Hyaluronic	Hyaluronic acid	Cetearyl glucoside	Oleic acid decylester	Cetearyl alcohol	Sodium lauryl sulphate	Sodium cetearyl sulphate	Glycerol
Ialuset plus compress	Hyaluronic	Hyaluronic acid	Silver sulfadiazine	Macrogol	Glycerol	Water		
Ialuset plus cream	Hyaluronic	Hyaluronic acid	Silver sulfadiazine	Cetearyl glucoside	Oleic acid decylester	Cetearyl alcohol	Sodium lauryl sulphate	Sodium cetearyl sulphate
Jaloplast gauze	Hyaluronic	Hyaluronic acid	Sodium chloride	Macrogol 4000	Glycerol	Cotton	Water	
Jaloplast gel	Hyaluronic	Hyaluronic acid	Sodium dehydroacetate	Methyl parahydroxybenzoate	Propyl parahydroxybenzoate	Polyacrylate	Sodium hydroxide	Sorbitol
Allevyn	Hydrocellular	Polyurethane	Silicone	Cellulose	Polyacrylate			
Askina dressil	Hydrocellular	Silicone	Polyurethane					
Biatain Ag dressing adhesive	Hydrocellular	Polyurethane	Carboxymethylcellulose	Silver				
Biatain silicone lite	Hydrocellular	Polyurethane	Silicone					
Biatain soft hold pans mousse	Hydrocellular	Polyurethane	Polyacrylate	Resin	Paraffin			

(Continues)

TABLE 1 | (Continued)

Products	Categories	Compound (C1)	C2	C3	C4	C5	C6	C7
Biatain-ibu soft hold	Hydrocellular	Polyurethane	Ibuprofen	Polyacrylate	Resin	Paraffin		
Combiderm dressing	Hydrocellular	Polyurethane	Cellulose	Polyacrylate	Polypropylene	Silicone	Pentalyn	
Mepilex Border Ag	Hydrocellular	Silicone	Polyurethane	Polyolefine	Silver sulphate	Polyester	Polyacrylate	Viscose
Mepilex lite	Hydrocellular	Silicone	Polyurethane	Polyamide				
Algoplaque	Hydrocolloid	Carboxymethylcellulose	Polyurethane					
Comfeel Ag dressing	Hydrocolloid	Carboxymethylcellulose	Polyurethane	Silver	Pentalyn			
Comfeel plus plaque mousse	Hydrocolloid	Carboxymethylcellulose	Polyurethane	Calcium alginate	Pentalyn			
Duoderm E dressing	Hydrocolloid	Carboxymethylcellulose	Polyurethane	Pectin	Gelatin	Polyisobutylene	Pentalyn	
Duoderm hydrogel	Hydrocolloid	Propyleneglycol	Pectin	Carboxymethylcellulose	Water			
Granuflex	Hydrocolloid	Carboxymethylcellulose	Pectin	Gelatin	Pentalyn			
Suprasorb H+	Hydrocolloid	Polyurethane	Carboxymethylcellulose	Polyisobutylene	Styrene	Silicone		
Varihesive thin	Hydrocolloid	Carboxymethylcellulose	Pectin	Gelatin	Polyurethane	Pentalyn		
Aquacel	Hydrofibre	Carboxymethylcellulose						
Aquacel Ag	Hydrofibre	Carboxymethylcellulose	Silver	Isocyanates				
Aquacel Extra	Hydrofibre	Carboxymethylcellulose	Cellulose	Isocyanates				
Durafiber	Hydrofibre	Hydroxyethylcellulose						
Braunol gel	Hydrogel	Povidone iodine	Macrogol 400o	Macrogol 400	Sodium bicarbonate	Water		
Flamigel	Hydrogel	Propyl parahydroxybenzoate	Carboxymethylcellulose	Methyl parahydroxybenzoate	Ethylene diaminetetraacetic acid	M1acrogol	Arginine	Branched chain fatty acids
Flaminal Forte©	Hydrogel	Calcium alginate	Macrogol	Hydroxypropylcellulose	Potassium sorbate	Glucose oxydase	Guaiacol	Lactoperoxidase

(Continues)

TABLE 1 | (Continued)

Products	Categories	Compound (C1)	C2	C3	C4	C5	C6	C7
Flaminal Hydro	Hydrogel	Calcium alginate	Macrogol	Hydroxypropylcellulose	Potassium sorbate	Glucose oxydase	Guaiacol	Lactoperoxidase
Granugel gel	Hydrogel	Carboxymethylcellulose	Pectin	Propyleneglycol				
Hydroclean gel	Hydrogel	Carboxymethylcellulose	Glycerol	Hydroxyethylcellulose	Ringer solution			
Intrasite gel	Hydrogel	Carboxymethylcellulose	Propyleneglycol	Water				
Purilon gel	Hydrogel	Carboxymethylcellulose	Calcium alginate	Water				
Solcoseryl gel	Hydrogel	Propyleneglycol	Methyl parahydroxybenzoate	Propyl parahydroxybenzoate	Carboxymethylcellulose	Calcium lactate	Deproteinized calf blood dialysate	Water
Tegaderm hydrogel	Hydrogel	Sodium tetraborate	Propyleneglycol	Guar gum	Water			
Adaptic gauze	Interface	Paraffin	Polysorbate 80	Sorbitan sesquioleate	Water			
Atrauman	Interface	Polyester	Glycerides	Diglycerylacryloadipate				
Atrauman Ag	Interface	Polyamide	Silver	Macrogol 2000	Glycerides	Glycerides		
Biogaze impregnated compress	Interface	Lanolin	Niaouli essential oil	Cotton	Linalol	Terpineol	Vaseline	Cupric chlorophyl
Cuticell contact classic	Interface	Paraffin	Cotton					
Flammatulle vaseline	Interface	Vaseline	Viscose					
Grassolind neutral	Interface	Glycerol	Vaseline	Wax	Cotton			
Jelonet tulle	Interface	Paraffin	Cotton					
Melolin compress	Interface	Polyacrylate	Polyester	Cotton				
Mepitel film	Interface	Polyurethane	Silicone	Polyamide				
Mepitel one	Interface	Polyurethane	Silicone	Polyethylene	Polyamide			
Urgotul Ag dressing	Interface	Carboxymethylcellulose	Silver	Vaseline	Polyester			

(Continues)

TABLE 1 | (Continued)

Products	Categories	Compound (C1)	C2	C3	C4	C5	C6	C7
Urgotul dressing	Interface	Carboxymethylcellulose	Paraffin	Polyester				

Products	C8	C9	C10	C11	C12	C13
Algisite M						
Algosteril						
Suprasorb A						
Suprasorb A + Ag						
Urgosorb dressing						
Biatain alginate						
Biatain alginate Ag						
Actisorb silver						
Promogran dressing						
Suprasorb C						
Mesoft compress						
Sterilux compresss						
Telfa compresss						
Zetuvit hartmann dressing						
Honeypatch dressing						
L-Mesitran ointment	Aloevera	Manuka honey				
Hyalo4 silver spray	Disiloxan	Propellant				
Hyalo4 regen						
Hyalo4 skin gauze						

(Continues)

TABLE 1 | (Continued)

Products	C8	C9	C10	C11	C12	C13
Hyalo4 skin cream	Macrogol	Oleic acid decylester	Fragrance	Water		
Hyalo4 skin gel	Water					
Hyalo4 start						
Hyalo4 control	Oleic acid decylester	Water				
Ialuset compress						
Ialuset cream	Sorbitol	Sorbic acid	Methyl parahydroxybenzoate	Propyl parahydroxy benzoate	Sodium citrate	Water
Ialuset plus compress						
Ialuset plus cream	Glycerol	Sorbitol	Sorbic acid	Methyl parahydroxy benzoate	Propyl parahydroxybenzoate	Sodium citrate
Jaloplast gauze						
Jaloplast gel	Water					
Allevyn						
Askina dressil						
Biatain Ag dressing adhesive						
Biatain silicone lite						
Biatain soft hold pans mousse						
Biatain-ibu soft hold						
Combiderm dressing						
Mepilex Border Ag						
Mepilex lite						
Algoplaque						
Comfeel Ag dressing						
Comfeel plus plaque mousse						

(Continues)

TABLE 1 | (Continued)

Products	C8	C9	C10	C11	C12	C13
Duoderm E dressing						
Duoderm hydrogel						
Granuflex						
Suprasorb H+						
Varihesive thin						
Aquacel						
Aquacel Ag						
Aquacel Extra						
Durafiber						
Braunol gel						
Flamigel	Colloïdal acid	Water				
Flaminal Forte©	Buffer	Water				
Flaminal Hydro	Buffer	Water				
Granugel gel						
Hydroclean gel						
Intrasite gel						
Purilon gel						
Solcoseryl gel						
Tegaderm hydrogel						
Adaptic gauze						
Atrauman						
Atrauman Ag						
Biogaze impregnated compress						
Cuticell contact classic						
Flammatulle vaseline						
Grassolind neutral						

(Continues)

TABLE 1 | (Continued)

Products	C8	C9	C10	C11	C12	C13
Jelonet tulle						
Melolin compress						
Mepitel film						
Mepitel one						
Urgotul Ag dressing						
Urgotul dressing						

3 | Results

Table 1 shows the list of seventy-three modern dressings included in our survey. Each row corresponds to a unique dressing and its composition. The first column lists the name of each product, followed by their respective categories in the second column. Our database includes ninety-eight different compounds and up to thirteen different distinct compounds per dressing, classified into eleven categories: alginate, carbon, collagen, gauze, honey dressings, hyaluronic, hydrocellular, hydrocolloid, hydrofibre, hydrogel and interface. Table 2 shows the main allergens found in modern dressings. Honey dressings contain the most compounds, followed by hyaluronic acid dressings and hydrogels. Alginate dressings and hydrofibre contain few components and are used for their absorbency. Hydrocolloids contain a low concentration of carboxymethylcellulose and are used for low exudation wounds. They also may contain rosin derivatives. Hydrocellular dressings have a higher absorbency compared to hydrocolloids, but slightly lower absorbency than hydrofibre. They contain carboxymethylcellulose, as well as acrylates, polyurethane or silicone, which differentiates them from other dressings. Furthermore, alginate, carbon, hydrofibre, hydrocellular and hydrocolloid dressings may contain silver.

4 | Discussion

In the management of chronic leg ulcers, a wide array of topical agents, including various antiseptics and dressings, are often used concurrently. This common practice has been linked to an increased risk of contact sensitisation. Some studies suggest that an extended healing duration correlates with the use of a greater assortment of wound care products, which may increase the risk of sensitisation to components of these treatments. However, some other studies report ambiguous findings regarding the relationship between the duration of leg ulcers and the frequency of contact sensitisation [8, 10]. Our database analysis confirms that *myroxylon pereirae* has been eliminated in the composition of medical devices in Belgium. The occurrence of sensitisation to allergens in carba mix may be explained by their presence in compression bandages, commonly used for leg ulcers and venous insufficiency [2]. In Valois's study, 19.2% of patients were found to be sensitised to a modern dressing [8], a rate that is higher than what we observe in our practice. This discrepancy highlights the possibility of under-reporting or missed allergens in everyday clinical settings, emphasising the need for thorough allergen detection and accurate reporting.

Alginates are extracts of brown seaweed and serve as the foundational substance in both pure and mixed dressings. These dressings may also contain carboxymethylcellulose and silver ions. The Valois study reported a sensitisation rate of 1.7% for the pure calcium alginate product, Algosteril [8]. Tomljanovic's study identified a 1.6% sensitisation rate to alginates, although the author does not cite the specific implicated dressings [11]. Hydrocellular dressings contain more compounds than alginates, including polyurethane, carboxymethylcellulose, polyacrylates and silicone. Some cases of contact dermatitis to these dressings are reported. Hydrocellular dressings contain polyurethane, made from polyols, namely polyester or polyether

TABLE 2 | Main allergens found in modern dressings.

Alginate: Calcium alginate, CMC
Honey dressing: Manuka honey, chestnut honey, calendula officinalis, isocyanates, lanolin
Hyaluronic: Hyaluronic acid, parabens, cetearyl alcohol, sodium dehydroacetate, Hydrocellular: CMC, isocyanates, acrylates, limonene
Hydrocolloid: CMC, isocyanates, colophanium derivatives (pentalyn), limonene
Hydrofibre: CMC, isocyanates
Hydrogel: CMC, calcium alginate, parabens, propylene glycol, imidazolidinyl urea, sorbic acid, potassium sorbate
Interface: Paraffine, cotton, acrylates, isocyanates, sorbitan monooleate and sorbitan sesquioleate Legends
CMC: Carboxymethylcellulose

varieties, and isocyanates such as diphenylmethane diisocyanate and toluene diisocyanate. Diamonidiphenylmethane is recognised as a reliable biomarker for hypersensitivity to diphenylmethane diisocyanate, given the possibility of cross-reactivity with substances like paraphenylenediamine and benzocaine [12]. The adhesive margins of polyurethane foams may contain copolymers such as butyl methacrylate and methyl methacrylate. Isocyanates are well known to be involved in occupational asthma in industrialised countries, less frequently in adhesive medical devices and modern dressings. Dendooven et al. report relevant contact dermatitis to toluene diisocyanate and isophorone diisocyanate in hydrofibre and adhesive dressings [13]. In the study of Garval and Valois, 1.4% of patients have contact sensitisation to Mepilex border lite [9], while sensitisation rates to Biatain were found to be 2.7% and 4% respectively. Valois identified a statistically significant association between sensitisation to carboxymethylcellulose and Biatain ($p = 0.0171$). Furthermore, 0.6% of patients in Valois's study have a reaction to ethylene glycol dimethacrylate. Spencer reported seven cases of (meth)acrylate contact dermatitis, with Mepilex border lite implicated in four cases; notably half of these cases showed positive patch test reactions to butyl acrylate [14, 15]. Most recently, lauryl polyglucose has been implicated in contact allergy to Kendall dressings [16].

Hydrocolloid dressings, which typically include polyurethane, carboxymethylcellulose and sometimes pectin-gelatin or polyisobutylene, are frequently associated with colophonium derivative tackifiers as a cause of contact allergies. The most common allergens in this category are ester gum rosins (glyceryl rosinate), polyisobutylene derivatives and Pentalyn (pentaerythritol ester of hydrogenated rosin) [6, 17]. Pentalyn appears to be the most sensitising agent, and it does not always elicit cross-reactions with unmodified colophonium [8, 18, 19], potentially explaining the lack of association found in certain studies between colophonium sensitisation and hydrocolloid dressings ($p = 1$). Studies by Valois and Barbaud showed sensitisation rates to DuoDERM E at 5.1% and 4%, respectively, with Barbaud's study demonstrating a significant association between Pentalyn and DuoDERM E [20]. Moreover, Dendooven et al. [21] reported a contact allergy to colophanium due to the presence of limonene in adhesive dressings, some of which were labelled as hypoallergenic. Additionally, there have been a few case reports indicating allergic reactions to carboxymethylcellulose in a hydrocolloid dressing such as Comfeel [10]. It is important to acknowledge that the polyisobutylene present in hydrocolloids may contribute to contact dermatitis [5]. Hydrofibre dressings are primarily composed of carboxymethylcellulose or hydroxyethylcellulose, which have the potential to cross-react. Despite this possibility, the literature does not document any confirmed allergic reactions to hydroxyethylcellulose. Carboxymethylcellulose is known to be highly absorbent and is incorporated into an extensive array of products, ranging from medical devices such as artificial tears and dental adhesives to everyday consumer goods, including ice cream, toothpaste, candies and instant noodles [22, 23]. Despite its widespread utility, carboxymethylcellulose has been discontinued in patch test markets, leading to a reduction in rate's sensibilisation in wound dressings. Garval and Valois reported sensitisation rates to Aquacel at 2.7% and 1.4% respectively. It is also noteworthy that contact allergy to silver ions embedded in these dressings can occur, but it remains rare [24]. As previously mentioned, Aquacel has been implicated in contact allergies to toluene diisocyanate and isophorone diisocyanate [13].

Hydrogels, composed of water, exceeding 70%, are complex matrices, which contain various compounds. These substances have been associated with skin reactions such as allergic contact dermatitis and irritant contact dermatitis, the latter often manifesting as maceration. Among the myriads of potential allergens, propylene glycol and other related glycols stands out as a frequent culprit. In the extensive cohort study by Lessmann [25] a 2.3% prevalence of positive reactions to propylene glycol was observed among 45 138 participants. However, Valois's study did not establish a significant correlation between propylene glycol and hydrogel-related contact dermatitis ($p = 1$). While propylene glycol has been a longstanding suspect in contact allergy to hydrogels, recent findings have brought to light other sensitising agents, such as imidazolidinyl urea [26]. A case of contact allergy to Purilon, which contains water, carboxymethylcellulose and calcium alginate, but lacks propylene glycol, has been described. We use the Flaminal range very regularly in our practice. Both Flaminal Forte and Flaminal Hydro share similar ingredients, yet they differ in the concentration of certain elements, particularly in calcium alginate. Flaminal Forte which contains higher concentration of calcium alginate, is specifically formulated for managing highly exudative wounds. Sorbic acid and its salt, potassium sorbate, are also known to cause

contact dermatitis to Flaminal. As sorbic acid is stable in ethanol and potassium sorbate in water, false-negative reactions may occur when petrolatum is used to patch tests these compounds [27].

The prevalence of contact allergy to hyaluronic acid dressings is on the rise. Valois's study identified sensitisation in forty-five of 354 patients, while Barbaud's research [20] reported sensitisation in two of 423 patients to Ialuset cream, which is composed of thirteen different compounds. Milpied's investigation [28] pinpointed cetostearyl alcohol and sodium dehydroaceteate as the primary sensitisers in Ialuset cream. Our findings suggest a broader spectrum of potential allergens, including hyaluronic acid and parabens among others.

Nonadherent dressings typically contain cotton, paraffin or vaseline; additional compounds are unfortunately not always explicitly identified. Allergic reactions to paraffin are extremely rare, with only a handful of (doubtful) cases reported in the literature [29]. Garval's study involving seventy-three patients revealed no instances of contact allergy associated with Jelonet. However, Adaptic has been implicated in contact allergies in several articles and case reports [30, 31]. This dressing is known to contain sorbitan monooleate and sorbitan sesquioleate, with the latter being recognised for its potential to induce cross-reactions with various fragrances and composite mixes.

The absence of standardised guidelines for wound care has led to diverse practices across different times and regions. The selection of modern dressings for patients with leg ulcers is not uniform, varying significantly from one treatment centre to another. This variability is a plausible factor contributing to the disparate rates of contact sensitisations in various studies [10]. Our database has been developed to highlight the main allergens in modern dressings. This resource is intended to enhance our ability to conduct targeted testing for our patients and to identify suitable alternatives for their treatment. We suggest conducting patch tests on leg ulcer patients using a variety of batteries, including standard, leg ulcer and customised modern dressing batteries (one dressing tested per category), as well as the patients' own dressings. Looking ahead, we aspire to achieve increased transparency from manufacturers of modern dressings, which would facilitate more precise testing for our patients.

Modern dressings have been designed to accelerate wound healing and improve patients' quality of life. Despite their benefits, the potential for allergic contact dermatitis remains a concern. The challenge of identifying specific allergenic components in dressings necessitates a comprehensive approach to testing. As a proactive measure, it is imperative to conduct patch tests on leg ulcer patients using a variety of series, including standard, cosmetic, leg ulcer and customised modern dressing series, as well as the patients' own dressings. This article may help identifying relevant allergens and providing clinicians with an accessible reference tool. This tool will undergo continual expansion and updates, ensuring its relevance and utility. We are committed to sharing this database at no cost with fellow clinicians to foster collaborative progress in the field. The complexity of delayed wound healing underscores the necessity for such resources. It is our aspiration that this study will prove to be a practical asset to clinicians worldwide. The primary limitation of this database lies in the inadequacy of the European legislation on medical devices, established in 2017 (Regulation EU 2017/745 and EU 2017/746) [32]. Despite progress in product labelling, the current regulations fall short, as they do not compel companies to disclose the complete composition of their products. In conclusion, our findings indicate that hydrofibre alginates and certain nonadherent dressings pose the least risk of sensitisation, while hydrogels, hydrocolloids and adhesive hydrocellular dressings are potentially the most problematic.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

This work is entirely the product of my own research and reflections. I have not used any ghostwriters, and all contributors are clearly identified.

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