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Emollients and the foot

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INTRODUCTION

The human skin is a complex organ with many functions. One of its primary roles is as a water-repellent surface, limiting water loss from the deeper tissues as well as preventing the ingress of noxious chemicals into the body. This function has been termed the 'skin barrier'. The loss of the skin barrier can lead to drying of the skin and may predispose to a range of conditions including infection, sensitivity and allergy. Restoration of normal skin function can be facilitated by the use of emollients (also referred to as moisturisers).

Although often considered bland products, the regular application of emollients can help improve a range of skin symptoms and conditions such as dryness, psoriasis and eczema. Despite emollients being recommended frequently by podiatrists and chiropodists, evidence suggests that patients require information on appropriate selection and use to ensure success. This CPD article will provide a review of emollients, their application and effects with specific reference to the lower limb and foot.

Normal skin function

In order to understand the actions and effects of emollients it is important to review the normal physiology of the skin. The skin is divided into two main regions, the dermis and the epidermis. The underlying dermis provides nourishment through its blood supply to the overlying epidermis and contains the cells responsible for immune and repair functions along with a range of sensory nerve endings. The avascular epidermis constantly generates new epithelium by mitosis of the cells within the basal layer just above the dermo-epidermal junction. In around 28 days, cells ascend the epidermis from the basal layer through the strata spinosum, granulosum and finally into the lower levels of the stratum corneum (also known as the stratum compactum) before loosening in the outermost part of the stratum corneum, the stratum dysjunctum, and eventually shedding as invisible scale (Figure 1).

The main epithelial cell, the keratinocyte, as it ascends the layers of the epidermis undergoes a complex, pre-programmed process before sloughing off as a mature corneocyte. Moving through the epidermis, the keratinocyte cells become flattened and the nucleus degenerates. The structure of the epidermis has been likened to the structure of a brick wall which gives the human skin its waterproofing properties.¹ The keratinocyte acts as the brick whilst intercellular lipids coat the cells forming a water-tight

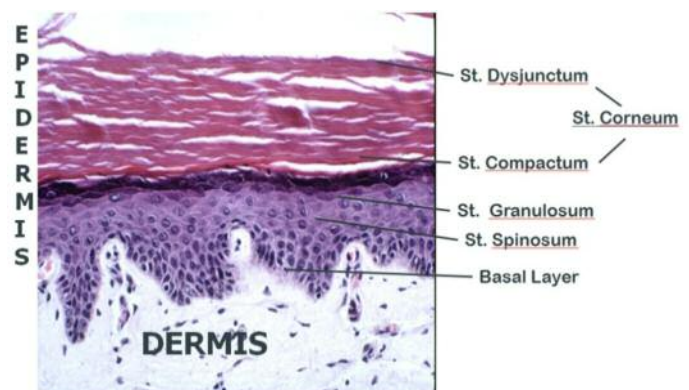


Figure 1: Microscopic structure of plantar skin

cement in the stratum corneum, reducing water loss from the underlying dermis and repelling entry of other liquid chemicals from the external environment. Within the granular layer, corneocytes produce keratohyalin granules, which expel their lipid contents into the intra-cellular spaces. In addition, keratinocytes enzymatically produce the lipids in the inter-cellular spaces, particularly essential fatty acids, cholesterol and ceramides – the skin's natural moisturisers often termed 'natural moisturising factors' (NMFs). Altogether, normal homeostasis in the skin provides an intact waterproof epidermis, which is smooth, flexible and protective.

So why does the skin barrier fail?

The normal skin barrier can be affected by many factors, leading to the symptoms of dry skin – also known as xerosis. Clinically, when confronted with a patient with dry skin one would seek to elucidate the possible causes (Table 1). An assessment of the medical history, bathing routines and medications may prove helpful. Firstly, when confronted with a patient with dry skin it is necessary to decide if the condition is physiological or pathological.²

Physiological dryness can affect the young but more often affects the elderly as part of age-related skin changes. With ageing, skin turnover slows along with the production of NMFs, resulting in varying levels of dryness. In women, the menopause has also been shown to affect skin quality. Other simple factors can play a part but are often overlooked. The act of washing can have a

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PHYSIOLOGICAL
Young or elderly
Menopause
Soaps, bubble baths and shower gels
Soaking the skin
Insufficient rinsing of skin cleaning products
Vigorous drying with a towel
Over-bathing
Temperature & humidity – air conditioning and central heating
Sun exposure
PATHOLOGICAL
Many skin conditions e.g. eczema, psoriasis, ichthyosis
Skin infection
Peripheral vascular disease
Iron deficiency anaemia
Hypovitaminosis (A,B,C and E)
Renal failure
Diabetes mellitus
Thyroid disease
Anorexia nervosa
Lymphoma and other internal malignancies
Drugs including statins, cimetidine, retinoids

Table 1: Causes of dry skin (xerosis)

profound effect. Bubble bath, soaps (including moisturising brands) and shower gels can dry skin significantly and remove NMFs, particularly when applied vigorously or when they are not rinsed fully from the skin after bathing. Moreover, even soaking in pure water for long periods (more than 15-20 minutes)³ can have a similar effect. Drying of the skin, such as vigorous towelling, can also accelerate desquamation, removing the important outermost waterproofing layers from the epidermis. A combination of more frequent bathing, showering, and towelling has led to much of the dry skin observed in patients today. Local climate has an effect too. Central heating or air conditioning can dry the skin, whilst changes in temperature can modify the skin's lipid production. Trans-epidermal water loss is accelerated when the ambient temperature is high and humidity is low. The net effect of excessive water loss can be a rise in the skin's natural pH, ultimately reducing the skin's ability to combat surface infection.



Figure 2: Dry skin (xerosis) affecting the foot due to ichthyosis

Pathological dry skin occurs due to the effect of disease, which may reduce NMF production or alter the keratinisation process itself. Skin diseases are a prime example of xerosis as many exhibit dryness as part of their symptoms. Atopic eczema is a common condition of childhood whereby natural lipid production of ceramides⁴ and other NMFs such as urea is impaired, leading to dryness and inflammation leaving the epidermis vulnerable to sensitisation and infection. Research has demonstrated this effect showing how atopic skin is highly colonised with *Staphylococcus aureus* as a consequence. Genetic disorders of keratinisation may lead to the production of defective corneocytes, which detach easily such as in ichthyosis (Figure 2). Often overlooked, skin infections such as tinea pedis can lead to the symptoms of dryness.⁵

Diabetes mellitus may lead to reduced sweat gland activity as a result of autonomic neuropathy, whilst co-existing skin infection, peripheral vascular disease and hyperglycaemia can further compound the problem. Deficiencies in vitamins A, B, C and E also affect the quality of skin. In addition, it is important to check a patient's medication as certain drugs can exacerbate the condition of the skin such as the widely prescribed statins, cimetidine and retinoids.²

EMOLLIENTS

The benefits

Of all the products recommended by podiatrists and chiropractors, emollients must be the most commonly suggested for patients. However, little attention is paid to the explanation and understanding given to the patient regarding appropriate selection, application and potential benefits. The term emollient, derived from Latin, is used to describe substances that soften and improve hydration within the skin such as moisturisers, soap substitutes and bath oils.

The range of available products and their usage may serve to confuse both the healthcare practitioner and patient alike. In essence, most products work on the principle of trapping or concentrating water content within the epidermis, replenishing corneocytes with water, causing them to swell⁶ (improving their apposition) and replacing depleted NMFs to improve waterproofing and restore the skin barrier function to the epidermis. Examples of a NMF include lactic acid, urea and glycerine, which are humectants that attract and hold water within the skin (often drawing water from the underlying dermis). Humectants are of particular value in very dry areas such as the plantar skin.

The main drawback of an emollient is its short-lived effect, requiring frequent reapplication to remain effective. However, immediately after application the skin feels smoother due to the filling in of cracks within the epidermis and has an increased flexibility.⁷ In addition, emollients have been demonstrated to stabilise skin function and reduce itching, inflammation and skin turnover.⁸ Also, regular use of emollients can enhance the effectiveness of concurrent topical steroid therapy meaning that if a patient moisturises their skin regularly, reduced doses of topical steroid are required to produce the same effect. Clinically this reduces the likelihood of steroid-related side-effects for the patient.

Types of emollient products

Currently, an array of emollient products exists for the consumer with a variety of constituents but essentially all contain a lipid (fat/wax/oil) base with varying degrees of water. The simplified diagram (Figure 3) demonstrates the spectrum of emollients, ranging from high-lipid concentration to lower-lipid concentration (with greater water content).

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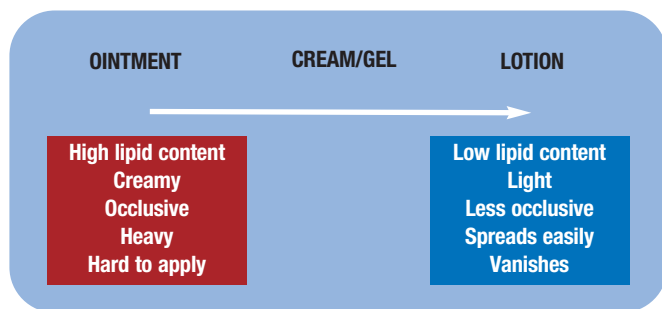


Figure 3: The spectrum of emollient products

High-lipid content preparations tend to be ointment based, and therefore heavier, more occlusive and harder to spread. Cosmetically, they are less well tolerated than lighter preparations such as creams and gels, which have a lower lipid content. Although creams and gels are less greasy, easier to spread and more acceptable to most, their moisturising capacity is lessened. Creams containing humectants may have similar efficacy to ointments but have the advantage of being less greasy. Table 2 outlines the definitions of each formulation.

Selecting an emollient

A quick glance through the British National Formulary (BNF) or the Monthly Index of Medical Specialities (MIMS) presents a bewildering array of creams, ointments and lotions indicated for dry skin (see Table 3), so difficulty often arises when selecting an appropriate product for patients. In addition, referring to the evidence base, comparing the efficacy of various products and formulations is limited⁹ and relies primarily on the clinical experience of those who deal with the problem on a regular basis. The latest statement on best practice in emollient therapy has reviewed a range of evidence and highlights the paucity of evidence to guide usage.¹⁰

In the absence of guiding evidence, patient choice in collaboration with the healthcare professional is essential. A range of emollient products exists and supplying the patient with a range of sample-sized products can be extremely helpful as emollient products selected by the healthcare practitioner may not be cosmetically suitable for the patient. In selecting a suitable product, the practitioner should also be aware if the patient has any known sensitivities to any of the ingredients within the preparations so they may be avoided (see the section on adverse reactions below).

Samples can be obtained, usually at no cost, from the manufacturers and given to the patient. Once products have been chosen that the patient is happy to use, larger quantities may be obtained from the pharmacy or, in some cases, by prescription from the GP. General considerations should also be given to the packaging format. Smaller tubes and small containers are useful to encourage patients to carry their emollients with them and keep them handy. Larger pots and tubs of emollient products present problems with use – opening the lid maybe difficult for arthritic patients. Moreover, dipping hands into tubs can lead to skin and bacterial contamination. In these cases patients should be asked to decant an appropriate amount using a spoon and reseal the tub as soon as possible. A better alternative is the use of a pump dispenser, which is easier for most to use and delivers a metered dose to prevent any wastage. Studies have confirmed a lower contamination rate for this type of device.¹¹

OINTMENT: A fat or grease based semi-solid medicament. Depending on the type of ointment base used, it has a varying capacity to contain water, usually as an emulsion.

CREAM / LOTION: These are two phase emulsions ranging from lighter oil-in-water emulsions to the reverse of water-in-oil types, which tend to be heavier. Lotions are much lighter and feel more liquid as they dilute oil-in-water emulsions

GEL: These are similar to creams but are formulated into a clear applicator that breaks down on application.

EMOLLIENT WASH PRODUCT: These act as skin cleansers but do not have the drying effects on the skin like soaps, bubble baths and shower gels.

Table 2: Definitions

Emollients and the foot

The skin on the foot is a unique area of the body, generally being devoid of active sebaceous glands, having a very thick epidermis on the plantar area and being placed in a shoe for considerable periods of the day. Consequently, additional measures may be required to ensure maximum effect from emollient therapy.

Firstly, the foot being a cooler, acral area is generally best suited to heavier ointment-based preparations that have a more occlusive effect than creams, but potentially this can be a problem with footwear. For moderately dry skin, patients may be best advised to apply lighter products such as creams and lotions when they are more active and on their feet, keeping the

Emollient Preparations	Urea Based Products	Bath Additives	With antimicrobials	With Antipruritics
Aquamol Cream®	Aquadrate®	Aveeno Colloidal® (Bath oil additive)	Dermol 600® (Bath/shower/wash)	Balneum Plus® Cream & bath oil
Aveeno® (Cream & lotion)	Balneum® Cream	Balneum® (Bath oil)	Emulsiderm® (Liquid emulsion)	E45® itch relief cream
Cetralben Cream®	Calmurid® (Cream)	Cetralben® (Bath additive)	Oilatum Plus® (Bath additive)	
Diprobath® (Cream & ointment)	Dermatronics® (Heel balm)	Diprobath® (Bath additive)	Zerolatum Plus® (Bath additive)	
Hydromol Cream® (Cream & ointment)	Eucerin® (Cream & lotion)	Doublebase® (Bath additive)		
Oilatum® (Cream & Junior cream)	Hydromol Intensive® (Cream)	Oilatum® (Bath additive)		
Doublebase® (Gel)		Zerolatum® (Bath oil)		
QV® (Cream & lotion)				
Zerobase® (Cream)				

Please Note: This list is not exhaustive of all available emollients

Table 3: Examples of emollient products

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- Emollients are best applied after bathing when the skin is slightly warm, damp and clean.
- Applying emollients to damp skin reduces the stinging felt on fissured feet.
- Skin should be dabbed and not rubbed with a towel prior to application.
- On hair-bearing skin such as the shin, an emollient should be applied downward along the lie of hair towards the foot (to prevent the emollient clogging the hair follicles causing folliculitis).
- On sensitive skin, emollients should be 'spread like butter on toast' and not rubbed in as this can irritate.
- Particularly on the plantar surfaces, products containing humectant can be more effective than a bland emollient. Likewise, an ointment-based product is a more effective base than a cream or lotion.
- The use of emollient products should be avoided on broken skin and around ulcers as this can promote sensitisation and allergy.
- On very dry feet, ointments can be applied and covered with a damp sock and then a dry sock over the top and left on overnight. This provides intense moisturisation for very dry feet.
- Patients should be encouraged to use emollients all over their skin where possible and substitute soap and shower gel with emollient wash products.
- Patients should always be advised to use bath oils and emollients with care to prevent slipping. Bath mats can be helpful in these circumstances.

Table 4: Summary of how to apply emollients on legs and feet

more potent, heavier ointments for use in the evenings or overnight. To minimise disruption and soiling of sheets with ointments, a simple but effective approach is suggested below (see also Table 4):

- An ointment-based emollient is applied to both feet just before bedtime.
- A damp sock is applied over the foot.
- A dry sock is then applied over the damp sock.
- This is left on overnight and removed in the morning.
- Lighter cream-based products can be used during the day.

In addition, it is worth considering other aspects of products to ensure the most effective approach. In dry areas of the body, such as the foot, products with an added humectant provide a stronger moisturising effect. Typical humectants include urea and lactic acid. A small number of preparations contain antimicrobials (such as Dermalol®, Oilatum plus® and Zerolatum plus®) and these are probably best reserved for dry skin when infection is present.¹²

Beeswax	Imidurea
Benzyl alcohol	Isopropyl palmitate
Butylated hydroxyanisole	N-(3-Chloroallyl) hexamini-um chloride (quaternium 15)
Butylated hydroxytoluene	Polysorbates
Cetostearyl alcohol	Propylene glycol
Chlorocresol	Sodium metabisulphite
Edetic Acid (EDTA)	Sorbic acid
Ethylenediamine	Wool fat products
Fragrances	
Hydroxybenzoates (parabens)	

Table 5: Excipients that are known to cause sensitisation¹²

Complete emollient therapy

When considering a suitable product for a patient, often only a 'leave-on' product is considered by the podiatrist. Recently, the concept of complete emollient therapy has been proposed.¹³ The concept is that a 'leave-on' product alone may not be adequate and the addition of a soap substitute and bath oil or shower gel to increase effectiveness is recommended. Many emollient creams and ointments can be used in place of soaps when washing to prevent drying of the skin. The complete eradication of all soaps, shower gels and bubble baths will reduce drying of the skin during washing and bathing, enhancing the effect of the emollient products used. In order to ensure maximum patient compliance, it is important to discuss issues around how to apply and the quantities required if a successful outcome is to be achieved.¹⁴ Complete emollient therapy is not necessary for all patients, only those with generalised dry skin, but anyone can benefit from it and improve their skin condition.

The best approach is for the patient to bathe or shower using a bath oil or emollient wash product and when the skin is still damp apply a 'leave-on' product. This traps a double layer of moisture in the skin. Patients should always be advised to use a bath mat when using bath oils and emollient wash products as they can make bathroom surfaces slippery.

Dosages

Emollients should be applied as much as possible but, for most people, following a frequent dosage regime is limited by a busy lifestyle. For a person with dry skin, guidelines currently suggest that around 500g a week should be applied to the whole body.¹⁰ Published frequencies and amounts for specific areas such as the feet are difficult to locate, although using hands as an analogous area around 25g-50g a week has been suggested.¹² Working on the premise that a single 'pump' of emollient is approximately 1g in weight, this equates to around 4g for mildly dry feet and up to around 8g a day for very dry feet.

Adverse reactions

Adverse reactions to emollients are uncommon but can occur. They usually manifest in the form of irritancy or, less frequently, true allergy. Irritant reactions occur, not as an immune-mediated response but as a reaction by the skin usually within minutes of applying the emollient, and are characterised by redness and inflammation at the site of application. True allergy is an immune-mediated response that never arises on first exposure, but can subsequently occur as an immediate event or take up to 96 hours to manifest. Patients with a history of skin disease, particularly eczema, should be treated cautiously as this group has a higher rate of skin sensitivities.

In such cases it may be wise to apply a new emollient to a small test area for 48 hours to assess if any reaction occurs before instigating emollient treatment. Where persistent, unexplained allergic reactions occur, patients should be considered for referral for allergy testing to elucidate potential causative allergens.

As a general rule, the fewer the number of ingredients, the lower the chances of adverse skin reactions. Ointments have fewer additives and tend to give fewer problems to patients, whereas creams and lotions may contain more emulsifiers and stabilisers, increasing the possibility of problems. A list of common additives and excipients (inert substances added as a diluent or vehicle for a drug) that may give rise to skin irritation or allergy is given in the BNF¹² and MIMS has a free online resource outlining additives contained in all the commonly used emollients, thus allowing patients with known sensitivities to avoid specific products.

Case Study

Jean was a 69-year-old retired shop worker who was suffering from dry, itchy feet with fissures around her heels, which had been troubling her for a number of months. She also had dryness on her hands and legs. An assessment suggested no pathological cause so she was recommended Balneum Plus® by her podiatrist as it was a product that contained urea, ideal for the feet. In addition, it contained lauromacrogols, which could help with the itching. She was asked to apply a generous layer to her feet in the evening. At a subsequent appointment she admitted that remembering to apply the cream had been difficult, infrequently using it, so only small improvements were visible. So at her next appointment, in addition, her podiatrist suggested that she obtain Balneum Plus Bath Oil® and add this to her bath water, whilst substituting her regular soap with Balneum Plus®. At her follow-up appointment, her general foot and skin condition had improved with only minor changes to her daily routine.

Common additives that give rise to problems include parabens and various fragrances. A full list can be found in Table 5.

Historically, issues have been raised about lanolin sensitivity, which was a common additive in some emollient preparations. As Clarke¹⁵ reports, initially around 1.7% of patients were thought to be affected. Subsequent reformulations using a hypoallergenic form of lanolin have meant adverse reactions have become increasingly rare although cosmetic marketing continues to emphasise 'lanolin free' products.¹⁵ More recently, aqueous cream has been discussed widely in the literature as a cause of skin sensitivity. Research has shown that the use of the product as a 'leave-on' emollient can seriously reduce the normal skin barrier function due to the sodium lauryl sulphate contained within it. Consequently, its use is generally only advocated as a wash-on/wash-off soap substitute and not as a leave-on product.¹⁶

CONCLUSION

Dry skin is a common problem for many patients, particularly older adults. The proper use of emollients can be effective in managing this problem and reduce the effects of common skin disease. For effective use of these products it is important for the practitioner to be aware of their formulations and correct application. In addition, patients should actively be involved in the selection of a suitable product if a positive outcome is to be achieved.

AUTHOR'S NOTE: A full publication entitled '*Best Practice in Emollient Therapy – a statement for healthcare professionals*' is available from: http://www.bdng.org.uk/documents/T5p11_Emollient_Therapy_BP.pdf. This statement was originally published in 2007 but a revised version is due to be published shortly.

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DECLARATION

The production of this article has been funded by Almirall Limited. Almirall Ltd has had the opportunity to review this article and has no editorial control. The final editorial control resides with the author and editors. The views and opinions of the author/contributors are not necessarily those of Almirall Ltd.

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Post-reading activity

Questions

After reading this CPD article, the following questions may help to assess your understanding of the article

1. Describe the skin barrier and its function
2. Name some common causes of dry skin.
3. What is an emollient?
4. What is a humectant?
5. List some benefits to using emollients.
6. What type of emollient preparation is the most suitable for the feet?
7. How much emollient should be applied to the feet?
8. Why are pump dispensers considered better than traditional tubs of emollients?
9. Describe what is meant by Complete Emollient Therapy.
10. Where can you find a statement on best practice for emollient therapy?

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Notes

Key points	Learning outcomes
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