The role of emollients in the care of patients with dry skin

Summary

Dry skin (xerosis) is a common problem, and ranges from mild dryness through to severe dryness and skin breakdown. The use of emollients continues to be the main therapeutic approach to this problem. However, patients and healthcare professionals do not always appreciate the importance of emollient therapy, and are faced with an overwhelming choice of products. This article aims to review skin barrier function and hydration, the factors causing dry skin and some of the issues that surround the use of emollients.

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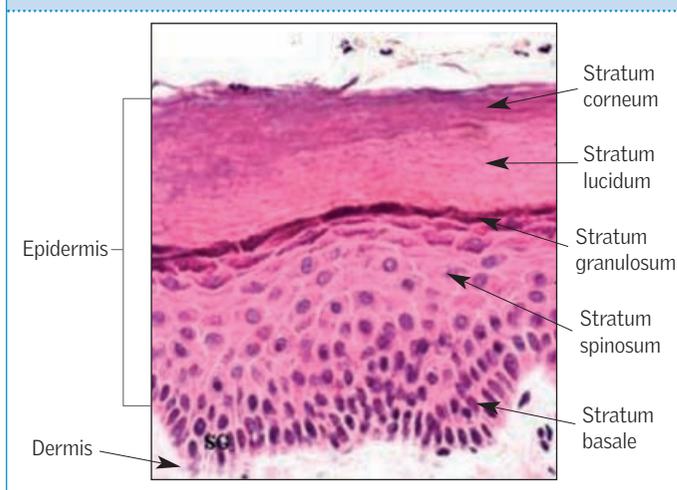
ALMOST EVERYONE will experience episodes of dry skin or xerosis at some stage in their life, with approximately 15% of GP consultations in the UK relating to skin disorders (McCormick *et al* 1995). For some this might be confined to the occasional mildly troublesome episode, while for others it becomes a chronic, irritating situation that may have a significant impact on quality of life, often being accompanied by more pronounced dermatological disorders such as eczema and psoriasis. Dry skin may also accompany many other chronic disease processes such as hypothyroidism and renal failure, or be the result of an adverse drug reaction, for example, lithium (Flynn *et al* 2001).

The use of emollients to maintain skin hydration and barrier function remains the principal treatment for dry skin conditions. Additionally they are often used to provide a barrier to protect vulnerable areas of skin such as the groin and buttocks in patients with urinary incontinence (Ersser *et al* 2005). Practitioners in

all spheres of nursing are likely to encounter individuals who have problems with dry skin and require interventions to restore skin barrier function, maintain integrity and prevent breakdown. Many healthcare professionals and patients do not consider emollients an active treatment and overlook their vital importance in the maintenance of intact healthy skin. The vast array of emollient products available means that appropriate cost-effective treatment choices may be difficult to make for the non-specialist. This article aims to explore normal skin barrier function, the factors that may lead to dry skin, the use of emollient therapy in the treatment of dry skin and some of the contemporary issues surrounding emollient therapy.

Normal skin barrier function

One of the major functions of healthy skin is the maintenance of a physical barrier against the external environment. This prevents the absorption of noxious substances and the entry of pathogens, as well as preventing excessive fluid loss from the body. Principally this is the role of the upper layer of the skin, the epidermis, and in particular the stratum corneum. The epidermis is situated above the dermis (Figure 1) and is composed of several discrete layers of cells known as keratinocytes. Keratinocytes are formed in the lower level of the epidermis, known as the stratum basale, and gradually migrate to the upper layers of the epidermis. During migration the appearance and characteristics of the cells change so that by the time they reach the stratum corneum they have changed from columnar, nucleated cells to flattened, dead keratinised cells with no nucleus, at which point they are termed corneocytes (Downing and Stewart 2000).

The process of keratinocytes transforming into corneocytes is known as epidermal differentiation. This constant supply of corneocytes from the lower epidermal layers might be considered one of the most important functions of the epidermis, ensuring the maintenance of an adequate barrier. The time taken for the epidermal cells to migrate

from the metabolically active basal layer to the keratinised stratum corneum is approximately 14 days in normal skin and a further 14 days before they are lost from the skin surface in a process known as desquamation (Clark 2004). Normally, corneocyte desquamation is in balance with epidermal differentiation and the replacement of new corneocytes so that it is not noticeable. Rather than being a random process, desquamation appears to be controlled by the action of several proteolytic enzymes, although the exact mechanisms involved are not fully understood (Harding 2004). Thus any disruption to the stratum basale will not become apparent for up to four weeks.
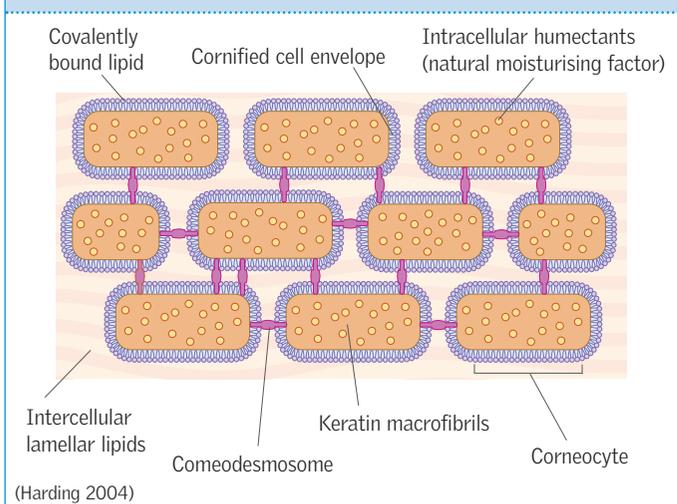
FIGURE 1

Transverse section of the skin

Epidermis

Dermis

Stratum corneum

Stratum lucidum

Stratum granulosum

Stratum spinosum

Stratum basale

SG

FIGURE 2

Model of the stratum corneum

Covalently bound lipid

Cornified cell envelope

Intracellular humectants (natural moisturising factor)

Intercellular lamellar lipids

Comeodesmosome

Keratin macrofibrils

Corneocyte

(Harding 2004)

Simple models of the stratum corneum barrier suggest a 'bricks and mortar' arrangement (Figure 2) with the protein-rich corneocytes acting as the bricks, held together by a lipid-rich matrix (Elias 1983, Cork 1997). Epidermal differentiation leads to the eventual production of the keratin and filaggrin filled corneocytes, and other specific proteins that form the cornified envelope proteins that surround the corneocytes (Proksch and Lachapelle 2005). Lipids are produced during epidermal differentiation and originate from the lamellar bodies that are expelled from keratinocytes in the stratum granulosum. Enzymes within the epidermis act on phospholipids to produce a mixture of ceramides, free fatty acids and cholesterol (Harding 2004). Crucial to the maintenance of the stratum corneum lipids, and therefore barrier function, is the essential fatty acid, linoleic acid (Prottey 1976). It has been suggested that the epidermis is one of the most active sites of lipid synthesis in the body, requiring the production of 100-150mg of lipid per day to replace that lost by desquamation (Elias 1991).

As well as a rigid protein structure, the corneocytes contain substances that actively attract and hold water in the stratum corneum. Collectively they are known as natural moisturising factor (NMF) and the increase in intracellular water they promote helps the corneocytes to retain their turgidity and shape, thus maintaining a coherent barrier. This also helps to maintain skin hydration which in turn helps to maintain flexibility and elasticity (Harding 2004). NMF is principally derived from the breakdown of the protein filaggrin, and consists of a complex mixture of free amino acids, amino acid derivatives and salts (Table 1). NMF acts as an effective humectant and by absorbing water from the atmosphere it enables the outermost layers of the skin to remain hydrated, despite the drying action of the environment (Rawlings and Harding 2004). More recent studies have highlighted the potential importance of another group of proteins in the maintenance of skin hydration, collectively known as aquaporins. These form channels which help regulate the flow of water within cells and are found throughout various tissues in the body (Verkman 2002). In the epidermis aquaporin 3 appears to have an important role in water balance, with altered amounts being identified in the skin of patients with atopic eczema (Olsson *et al* 2006). This is thought to contribute to the rapid and severe formation of dry skin seen in this condition.

Causes and characteristics of dry skin

Although dry skin or xerosis is often a permanent feature of many dermatological disorders, it may

also be a transitory occurrence that most individuals will experience at some stage in their lives, often occurring as a result of complex interactions between individual and environmental factors (Loden 2005). Some of the more common factors that can lead to dry skin are a low environmental temperature and low humidity (Ashida *et al* 2002), exposure to irritant chemicals (Morris-Jones *et al* 2002), over-use of soaps (Grunewald *et al* 1995), microorganisms (Cork 1996), ageing (Van Onselen 2000) and psychological stress (Garg *et al* 2001).

Differences between dry skin and healthy skin are evident on examination. Visually dry skin may appear dull, often with a flaky surface and patchy dry white areas. If severely dry, cracks and fissures may be visible and the surrounding skin may appear red indicating the presence of inflammation and possible secondary infection. Tactilely dry skin feels rough and uneven and the patient may experience a feeling of tightness. This may be accompanied by sensory changes such as tingling, itching or even stinging and pain. Physiological changes are also observed, with the stratum corneum of dry skin containing less water and NMF than that of healthy skin. The healthy stratum corneum has a relatively high water content of 15-20% and if this falls to less than 10% the skin surface displays fine scaling and feels rough (Clark 2004). Low intercellular lipid levels in the stratum corneum, particularly ceramides, have been found in patients with eczema (Di Nardo *et al* 1998).

In healthy skin, NMF is found in abundance in the corneocytes and accounts for up to 20% of the weight of the stratum corneum (Laden 1967). Low levels of NMF are associated with severe cases of xerosis and filaggrin levels have been shown to fall with age leading to a reduction in NMF production (Takahashi and Tezuka 2004). More recently it has been discovered that mutations in the gene responsible for the production of filaggrin are present in individuals with the common dry skin condition of ichthyosis vulgaris and may also be implicated in the development of eczema. The mutation leads to a reduction in filaggrin content in the stratum corneum, disrupting the normal homeostatic mechanisms that maintain skin hydration. Consequently severe drying and flaking of the skin occur (Sandilands *et al* 2006, Nomura *et al* 2007). Ultimately dry skin is unable to provide the protective barrier function essential for health. It is more permeable, leading to high levels of transepidermal water loss and has a reduced ability to resist the absorption of substances that may come into contact with the skin surface or the entry of microbes.

Clinical measurement of dry skin

Several grading scales have been developed for clinical use to assess the severity and extent of dry skin disorders and to evaluate the effectiveness of treatments (Box 1). These have often been developed on an *ad hoc* basis to meet the needs of a particular patient group or research design. While these scales have their uses, they also have limitations in that they rely on all members of the clinical team using them appropriately, leading to subjective results. Differing systems also make comparisons between studies difficult. Because of these problems attempts have been made to standardise scoring systems and guidelines have been developed for their use by the European Expert Group on Efficacy Measurement of Cosmetics and other Topical Products (EEMCO) (Serup 1995) (Box 1).

More objective measures of the extent of skin dryness and impaired barrier function may be obtained by the use of specially designed instruments. Stratum corneum hydration may be

TABLE 1

Chemical composition of natural moisturising factor found in the epidermis

Substance	Composition (%)
Free amino acids	40.0
Pyrrolidone carboxylic acid	12.0
Lactate	12.0
Sugars	8.5
Urea	7.0
Chloride	6.0
Sodium	5.0
Potassium	4.0
Ammonia, uric acid, glucosamine, creatine	1.5
Calcium	1.5
Magnesium	1.5
Phosphate	0.5
Citrate, formate	0.5

(Adapted from Rawlings and Harding 2004)

assessed using a corneometer, which measures the electrical capacitance of the skin surface and is related to water content (Dikstein *et al* 1986). The measurement of transepidermal water loss has become the 'gold standard' indicator of skin barrier function, with increases in water loss occurring as a result of disruption of the skin barrier. These devices have permitted the objective study of the efficacy of a number of emollient therapies. However, the cost of such instruments prohibits their use in general settings, being reserved for specialist centres or as research instruments. Ultimately the nurse caring for the patient with dry skin must rely on clinical judgement and patient experience when assessing the severity of skin dryness and the effectiveness of treatment.

Composition of emollients and actions

The term emollient is derived from the Latin meaning to soften and implies a substance that acts to smooth the skin surface. Commonly the terms emollient and moisturiser are interchanged as they perform similar functions in terms of increasing hydration of the stratum corneum. Traditionally emollients have worked by creating an inert barrier over the skin surface, trapping moisture underneath (Holden *et al* 2002). This traditional approach to understanding how emollients work has created a number of problems, with many practitioners and patients not perceiving emollients to be 'active treatments', leading to underuse and issues with concordance (Loden 2005).

Current emollients are available in the form of sprays, lotions, creams and ointments. Whatever form they take, the basic principle remains the same, namely they are all variations of oil (lipid) and water emulsion. Technically these emulsions may take the form of oil-in-water, or water-in-oil, with oil-in-water emulsions being the most common (Loden 2005). Emulsifying agents and surfactants such as cetostearyl alcohol and isopropyl myristate, are commonly added to increase stability and improve the product by enabling the use of less oil, therefore reducing the overall greasiness of the emollient and making it more acceptable to the patient. The oil content increases as an emollient moves from being a lotion to a cream, to an ointment. To increase the moisturising effects of emollients additional agents, known as humectants, may be added such as propylene glycol, urea and glycerol. These tend to be hygroscopic chemicals, which mean that they attract and absorb water from their surroundings, thus helping to attract water into the stratum corneum when applied topically. The rich mixture of lipid and water makes an ideal breeding ground for bacteria, so in many cases agents to inhibit bacterial growth are needed, such as benzalkonium chloride or hydroxybenzoates.

Occasionally, sensitivity to emulsifying agents, preservatives and other additives may occur, leading to contact dermatitis and exacerbating the original problem (Fan *et al* 1991, Powell 1996) (Box 2). This has been highlighted by Cork *et al* (2003) who showed an increased incidence of irritant skin reactions in children who used aqueous cream. Often the most common types of reaction to emollient preparations are sensory, particularly when applied to dry, cracked or periwound skin. Lotions and creams may cause a stinging or burning sensation as a result of the preservatives and particularly if a humectant such as urea is present (Peters 2005).

Selecting an appropriate emollient

A greater understanding of the dynamic processes involved in maintaining skin hydration and barrier function has resulted in a huge increase in available emollient preparations. The sophisticated components of many emollients now place them equidistant between drugs and cosmetics and can lead to confusion when trying to select the most appropriate product (Brown and Butcher 2005). However, the key to success lies with ensuring that an accurate assessment has been made of the patient's skin and potential causes of dry skin. Although greasier products (ointments) are thought to be more clinically effective, many patients dislike the consistency of these and find the residual staining of clothing and bedding highly unacceptable. Preference is generally expressed for rapidly absorbed lotions and creams, particularly if being used on visible parts of the body (Holden *et al* 2002).

Surprisingly, despite the acceptance of emollient therapy as the main treatment for dry skin conditions, there is a lack of good quality evidence on their effectiveness or adequate comparison of the various compositions (Rees 2002). Thus it is almost impossible to defend the use of one particular emollient over another. The recent publication of an article in the *Drug and Therapeutics Bulletin* (*DTB* 2007) questioning the benefits of bath emollients for people with atopic eczema has only served to intensify this debate. Based on a consensus of clinical opinion and experience, the topical application of emollients should continue to form the basis of treatment for dry skin conditions such as eczema. In most cases the decision of which one to use is largely influenced by patient preference or cost

(Ellis *et al* 2003). However, this unrestricted access to emollients is supported by patient groups, such as the Skin Care Campaign (SCC), who state that restricting which products may be used restricts patient choice and reduces concordance with treatment (Stone 2005), a statement that has been repeated by the SCC in response to the DTB article. It has been stated that the most effective emollient is the one that the patient likes and therefore will actually use (Burr 1999, Gradwell 1999).

Patient education

Despite acknowledgement of the widespread benefits of emollients in the management of dry skin, they are often used incorrectly or accompanied by conflicting advice from healthcare professionals (Holden *et al* 2002). A good illustration of this is the advice offered to patients receiving topical corticosteroids and emollients, as in eczema. There is no firm evidence base regarding the sequence of applying emollients and topical corticosteroids. This often leads to confusion among healthcare professionals and patients. Flohr and Williams (2004) in a review of the management of atopic eczema found evidence for applying emollients before the topical corticosteroid, to ensure that the stratum corneum is well hydrated and therefore make it easier for the corticosteroid to enter the skin, and for applying topical corticosteroids before emollients to reduce the

<table>
<tr><td colspan="2">**BOX 2**</td></tr>
<tr><td colspan="2">**Potential sensitisers found in emollients**</td></tr>
<tr>
<td>
▸ Beeswax
▸ Benzyl alcohol
▸ Butylated hydroxyanisole
▸ Butylated hydroxytoluene
▸ Cetostearyl alcohol (including cetyl and stearyl alcohol)
▸ Chlorocresol
▸ Edetic acid
▸ Ethylenediamine
▸ Fragrances
</td>
<td>
▸ Hydroxybenzoates (parabens)
▸ Imidurea
▸ Isopropyl palmitate
▸ *N*-(3-Chloroallyl) hexaminium chloride (quaternium 15)
▸ Polysorbates
▸ Propylene glycol
▸ Sodium metabisulphite
▸ Sorbic acid
▸ Wool fat and related substances, including lanolin
</td>
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<tr><td colspan="2">(British National Formulary 2007)</td></tr>
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risk of diluting the topical corticosteroid. In both situations it is suggested that a variable period of time is allowed between each application, and again the advice offered varies. Flohr and Williams (2004) recommended leaving a gap of one hour between applying the corticosteroid and then the emollient. While Gradwell and McGarvey (2006) suggested that corticosteroids should be applied at least 30 minutes after emollients. Current prescribing advice recommends the corticosteroid first, followed by the emollient at least 30 minutes later (Clinical Knowledge Summaries 2005). This has been highlighted in a study that examined whether

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dermatology nurses applied emollients before or after other topical applications; 48% replied before, 30% after and 22% at the same time (Penzer 2005).

There is one example where the interaction of emollients with other topically applied substances has been studied and where clear guidelines exist. This is the case where the new topical immunomodulating agents, tacrolimus and pimecrolimus, are being used. Both drugs are licensed for the treatment of moderate to severe atopic eczema if conventional therapy is not working and are thought to work by modulating T cell responses and suppressing the inflammatory response (Ruzicka *et al* 1999). The National Institute for Clinical Excellence (NICE) (2004) stated that emollients should not be used for two hours before or after the application of tacrolimus, although there are no such restrictions for pimecrolimus.

General advice should be given on the correct and most effective method of emollient application, such as applying immediately after bathing or showering and to rub in the direction of hair growth to reduce the risk of folliculitis (Burr and Penzer 2005). Patients often need help with

interpreting the instructions printed on pharmacy labels. Instructions such as 'apply liberally twice a day to the affected part' will mean different things to different people. Suggesting an amount as a measure the patient can visualise such as a dessert spoon may help. However, to achieve maximum concordance any treatment plan should be acceptable to the patient and manageable within the context of daily life.

Conclusion

An understanding of the role of the epidermis in maintaining an effective barrier has moved from a simple 'bricks and mortar' model, to a more complex one in which the epidermis has dynamic mechanisms for responding to the changing environment. This has increased understanding of the causes and mechanisms of dry skin and will lead to the development of more specific treatments targeted at the underlying causes. Emollients play a vital but underestimated role in the treatment and ongoing management of dry and chronic inflammatory skin conditions. Despite this important role, gaps exist in the evidence, and in particular with some of the more clinically relevant questions. By understanding some of these issues nurses are in a better position to advise patients, thus promoting effective use and concordance **NS**

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