The Society of Chiropodists and Podiatrists

Continuing Professional Development

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Hyperkeratosis of the foot: part 1

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Introduction

The plantar surface of the foot is a specialised area of skin. Despite its relatively small surface area, its integrity is essential for normal locomotion and health. The key to its role, in part, is the thickened, keratinised epidermis. The process of keratinisation is a normal physiological mechanism which maintains viability by the generation of new epidermal cells in the basal layer and differentiation of the cells ascending through the epidermis. By the time they have reached the stratum corneum cells have matured and finally desquamate from the surface of the epidermis.

When an area of skin shows thickening of the stratum corneum beyond that which is appropriate for the site, it is termed "hyperkeratosis"[1]. The most common cause of the condition on the foot is as a response to the intermittent forces of locomotion although many dermatological conditions may demonstrate hyperkeratosis as part of their pathophysiology. This article will review some of the causes of plantar hyperkeratosis and how they may be recognised clinically.

Table 1. Common causes of Plantar Hyperkeratosis

- Mechanically induced.
- Dermatological disease
- Infection
- Drugs

Approach to assessment

As with all assessments, when approaching a patient with hyperkeratosis, a standard procedure should be followed:

History
Examination
Further Tests

History should encompass the normal details collected including medical history, family history (with particular attention to skin disorders) and medication. In addition, inspection of the patient's footwear, an often neglected area, is important. Badly worn or incorrectly fitting shoes can lead to the development or aggravation of hyperkeratosis (see case study 1). Attention should be paid to the insock and lining as well as the sole and heel areas.

Examination should be carried out in a methodical fashion. Firstly, it is important to assess the skin of the foot and where possible legs, palms and arms. Many conditions may affect the palms concurrently and recognition of this can aid diagnosis. It is also pertinent to question the patient about other areas of skin which may not be available for examination. Other key aspects are bulleted below.

- Pattern of hyperkeratosis: symmetrical, asymmetrical, arch sparing?
- Appearance of lesions elsewhere on the skin?
- Texture: does this feel like normal mechanical keratosis?
- Is the hyperkeratosis easily lifted or well attached?
- Visual examination of individual lesions - magnifying lamp or dermatoscope.
- Fungal infection ruled out? Take skin scrapings if suspected.

Table 2. Examination of the patient with hyperkeratosis

- **Plantar surface**
  - Non-weight bearing or weight bearing areas?
  - Symmetry
  - Texture and characteristics
  - Background erythema
- **Legs and arms**
- **Palms**
  - Signs of hyperkeratosis may be more subtle here
- **Footwear**
  - Inspect the shoes most frequently worn
  - internal and external assessment of the shoe

Causes of Hyperkeratosis

In routine podiatry practice, mechanically induced skin changes are the most common cause of hyperkeratosis on the foot (as corns and callus). Thickening of the stratum corneum may be regarded as physiological response to mechanical trauma[2]. Burzykowski and colleagues[3] in a study of over 70 000 adult feet found that around 10% suffered with the condition with an increased prevalence in women and with ageing. Such lesions can be a source of high pressure and lead to complications such as ulceration in the diabetic foot[4]. Mechanically induced hyperkeratosis will be discussed further in a future CPD article.

Non-mechanical hyperkeratosis

Although no specific data is available, non-mechanically induced hyperkeratosis is probably less common in podiatric practice. From a clinician's point of view it is important to establish the differentiation between the mechanically induced and non-mechanically induced lesions as therapeutic success relies on elucidating the cause and selecting an appropriate treatment. For example, chronic, hyperkeratotic eczema on the plantar surface will not benefit from operative reduction and may lead to other complications (see case study 2). Table 3 lists some of the causes of non-mechanical hyperkeratosis. Due to the restrictions on the length of this publication it is not possible to cover all these in detail and the reader is encouraged to research the topic further if it is of relevance to their CPD needs.

Table 3. Causes of non-mechanical hyperkeratosis

- Skin Disease
  - Psoriasis
  - Eczema / dermatitis
  - Keratoderma blennorrhagica
  - Lichen planus
  - Keratoderma climactericum
  - Pityriasis rubra pilaris
  - Palmoplantar keratoderma
- Infection
  - Tinea pedis
  - Plantar warts
  - Scabies
  - Syphilis
- Drugs
  - Lithium
  - Verapamil
  - Bleomycin
- Systemic Disease
  - Hypothyroidism
  - Lymphoedema
- Malnutrition
  - Zinc deficiency
- Internal malignancies
  - Idiopathic

Skin Disease

Psoriasis affects around 2-3% of the population and in a subset of patients may affect the plantar surfaces either as part of widespread eruption or as localised disease. Classically, it presents as erythematous scaly plaques. Clues to its presence rely on its symmetrical presentation with sharply demarcated borders with a tendency to relapse and remit. Examination may reveal the disease elsewhere including the scalp, extensor surfaces of the elbows and knees. Fingernail involvement may include pitting whilst toenails tend to show onycholysis, sub-ungual hyperkeratosis and rapid growth. Lifting the scale may lead to pinpoint bleeding known as "Auspitz sign" which can aid diagnosis. On that basis, scalpel debridement of psoriatic lesions is not recommended. Management of the condition on the foot can be difficult although emollients may be helpful in softening the lesions. Topical steroids may be used to treat the condition, but withdrawal from them often leads to a worsening

of the psoriasis (a "rebound" phenomenon) and so they are seldom used. Dermatological management may include topical vitamin D derivatives, oral retinoids, ciclosporin and PUVA[5].

Eczema is another common skin disorder which may affect the foot. Causes can be internal or external (such as allergens, irritants or skin infections). Chronic eczema of the foot is hallmarked by hyperkeratosis and lichenification (exaggeration of skin creases with a leathery texture)[6]. Anecdotally, it may present as a diffuse plantar hyperkeratosis but with a brittle texture which bleeds when debridement is undertaken. Heel fissures are a common accompaniment to the disorder (see case study 2). Where fissuring and weeping are present, secondary bacterial infection, with staphylococcus aureus, is very common in patients with eczema[7]. Management, like psoriasis, requires emollients and topical steroids although antibacterial measures will be required to treat any co-existing infection if steroids are to be applied.

Contact dermatitis can occur anywhere on the feet, most typically as a result of sensitivity to adhesives, rubber, nickel buckles and leather dyes. Most commonly it is seen as symmetrical, hyperkeratotic areas on the dorsum of the feet, corresponding to the points of contact with the allergen. A thorough history and patch testing can help rule out other causes such as mechanical irritant dermatitis, eczema and psoriasis[8].

Keratoderma blennhorragica is an uncommon hyperkeratotic eruption of the soles which is virtually indistinguishable from plantar psoriasis. The condition is a cutaneous manifestation of Reiters disease, a seronegative polyarthritis seen particularly in young men with the B 27 haplotype.

Keratoderma climactericum is a hyperkeratosis of the soles which slowly develops in the heel and forefoot area and develops into non-itchy, hyperkeratotic plaques which subsequently fissure and become painful. With time lesions may develop on the palms. Generally, the lesions are round or oval in shape and are light in texture (See figure 1). Fungal infection should be ruled out by microscopy and fungal culture.

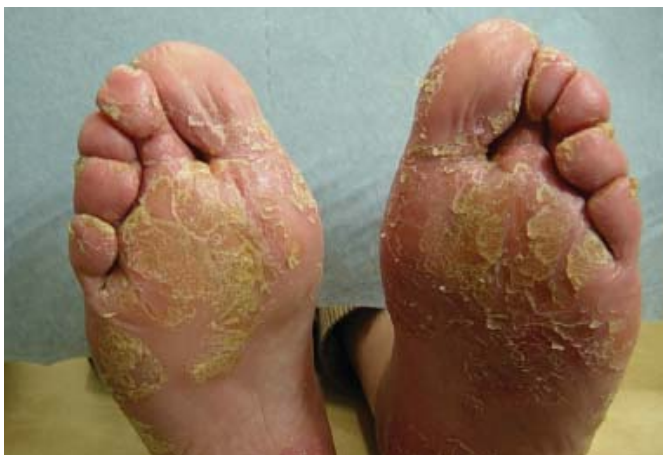

Figure 1: Keratoderma Climactericum

The disease was first described in 1934 by Hauxthausen who described the condition in menopausal women. Subsequently Gram[9] noted that typically women sufferers were moderately overweight, hypertensive and had arthritis of the knees[9]. Studies so far have been unable to show a link to fluctuating oestrogen levels although collagen structure has been demonstrated to be influenced by sex hormones[10] and may explain the disease. Management of the condition as a first step should include intensive emollient therapy[11]. Fissuring can be managed successfully with topical steroids as a cream/ointment or as an impregnated adhesive tape (Haelan®, Typharm Ltd). Under current access and supply, podiatrists are only able to access mildly potent topical corticosteroids (1% hydrocortisone) and so referral will be necessary to obtain the more potent steroid preparations.

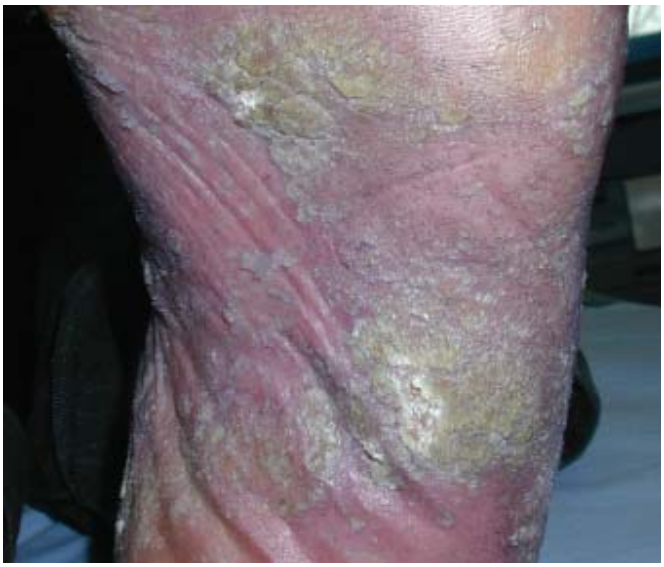

Figure 2 : Pityriasis rubra pilaris

Other dermatological conditions which may give rise to hyperkeratosis include lichen planus and pityriasis rubra pilaris. The former is characterised by itchy, purple flat topped papules around the ankles and wrists of adults. Occasionally, the condition may involve the plantar surface and present as diffuse, yellow hyperkeratosis. Rarely, ulcerations may develop on the sole[12]. Pityriasis rubra pilaris is an uncommon follicular hyperkeratosis which affects adults between the ages of 40 and 60 leading to scaly plaques with yellow-red appearance. Palmo-plantar involvement causes a diffuse hyperkeratosis (Figure 2). Most cases spontaneously resolve in 2-3 years but oral retinoids may hasten its remission. Retinoids are described further in the section headed PPK.

Infections

Warts commonly affect the foot and plantar lesions in particular may develop an overlying hyperkeratosis hampering topical treatment. Diagnosing the lesion is straightforward but lesions in immuno-suppressed individuals (such as transplant recipients) may be larger and more hyperkeratotic and require careful assessment, as malignant transformation is not uncommon in these patients[13]. Tinea pedis occasionally may

result in a mild plantar hyperkeratosis, particularly T rubrum infections. Diagnostically, a number of clues should be sought. Firstly, the skin appears dry with a chalky white appearance accentuated in skin creases[14]. Itching is often absent. The infection is usually asymmetrical, affecting one foot and can be confirmed by mycology. Management requires the use of topical antifungal agents or oral agents in more chronic infections. Attention should also be paid to the hands and groin which may harbour co-existing infection.

Secondary syphilis, although uncommon, produces a psoriasis-like eruption on the soles of the feet[15]. Typically beginning as coppery colour papules and macules, that develop a hyperkeratotic surface and central keratinous plugs.

Scabies is a contagious infestation of the skin by the Sarcoptes scabei mite. Symptoms of severe itching develop around 4 weeks after exposure, worse when the patient is warm. Typically, it may occur around the arch of the foot, mimicking eczematous-like eruptions in the very young. Debilitated and immuno-compromised patients may develop crusted scabies which presents as hyperkeratotic patches on the feet which are home to millions of active mites. Treatment in such cases is oral ivermectin.

Hyperkeratosis due to drugs and other chemical agents

Any patient presenting with a recent skin problem should be questioned about medications and other chemical agents which may be applied to the skin as a medicine or in the course of their occupation or recreational pursuits. Particular attention should be paid to any agents that were first used around the time the eruption began. Causation can only be confirmed if the drug is discontinued and the symptoms then subside. Drugs including lithium, gold salts, bleomycin, methyldopa and verapamil have all been implicated as occasional causes. Arsenic intoxication has also been shown to lead to the development of small, punctuate plantar keratoses identical to seed corns[16].

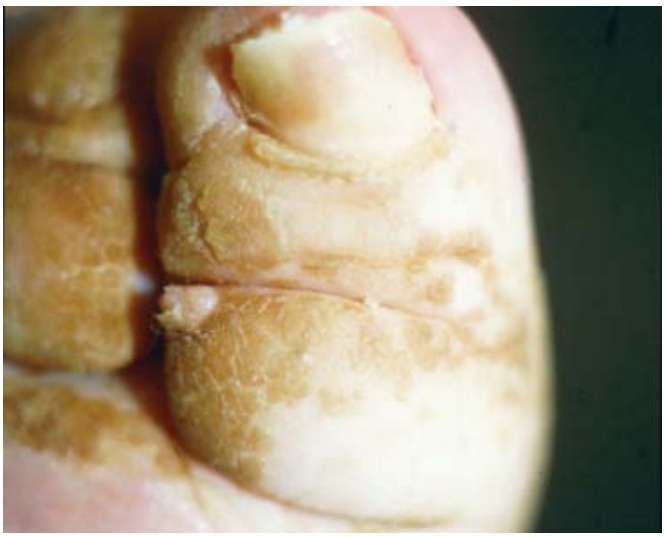

Figure 3 : Hyperkeratosis due to lymphatic failure (taken from Dawber, Bristow & Turner[18])

Lymphoedema

Chronic swelling of the leg has many causes. Typically lymphatic failure leads to a painless swelling of the leg and foot. Water logging of the dermis leads to a hyperplasia of overlying skin due to the presence of growth factors and cytokines. This in turn can lead to hyperplasia of the skin with velvety or warty like changes[17]. A brown coloured hyperkeratosis may occur overlying these plaques. Treatment for the underlying cause and reduction of the oedema along with good skin care can frequently reverse these changes (Figure 3).

Hypothyroidism

Rarely, hypothyroidism can lead to a diffuse plantar hyperkeratosis of the palms and soles. Typically the patients are middle aged with a more severe eruption on the palms than on the soles. The plantar surfaces may show patchy hyperkeratosis with fissuring. The condition appears to be unresponsive to topical steroids but shows rapid improvement upon thyroxine replacement therapy[19].

Palmo-Plantar Keratoderma

The term palmo-plantar keratoderma (PPK) is given to a diverse group of conditions which describe a hyperkeratosis concurrently affecting the palms and the soles of the sufferer. Traditionally, the term was used to describe those conditions suspected to be genetic in origin, although it is generally accepted that acquired types of PPK do occur as well. Conditions causing PPK are distinguished by their genetics, clinical appearance, symptoms and features additional to the palmo-plantar involvement. Stevens et al.[20] attempted to classify the disease by its presentation and described it as:

- Diffuse (widespread plantar involvement, usually arch sparing)
- Focal (discrete foci of thick hyperkeratosis on the plantar surface)
- Punctate (multiple corn-like presentation across the soles)
- PPK with ectodermal dysplasias (such as altered sweat functioning, deafness, abnormal dentition, nail deformities and neurological deficits)

Over 50 types have been described and many of the inheritable types have been well documented and readers are directed to a review article by Itin and Fistarol[21] for further information of specific conditions. Clinically, when confronted with suspected PPK it is important to obtain a full family history and examine the hands. Hyperkeratosis of the palms with these conditions may not be so obviously affected and subtle scaling and similar changes should be noted. Referral to a dermatologist may be required if a definitive diagnosis is being sought. Management of PPK can be frustrating and difficult. Owing to the thickness of the hyperkeratosis, emollients and other topical therapies have little effect. Oral retinoids are occasionally used to manage the condition under the direction of a consultant dermatologist. These drugs reduce cell turnover and as a result cause thinning of the epidermis, relieving symptoms for the patient. However,

the frequent side effects of the drug often mean a proportion of the patients are unable to sustain the drug regime long term. Typical side effects include dryness of the mouth, nose bleeds, hair thinning, altered liver function and skeletal hyperostosis.

Internal Malignancy and Hyperkeratosis

Hyperkeratosis of the palms and soles has been recognised as a marker of internal malignancy. A number of rare forms of PPK are known to be associated with an increased risk of developing internal cancers. For example, Howel-Evans syndrome is a familial form of PPK present in a small number of families. Of those members of the family who develop the palmo-plantar keratoderma, they hold a 95% chance of developing an oesophageal carcinoma in later life[22]. Other similar associations have been reported in patients with hereditary diffuse gastric cancer[23] and in a population with cancer of the oesophagus[24].

Aside from inheritable forms of PPK, a number of papers have published cases where PPK of the palms and soles has been a marker for internal malignancies of the lung, bladder, stomach and colon[25-27] often preceding any internal symptoms. Any adult patient presenting with a recent onset hyperkeratosis where a discernable cause is not apparent should be referred for medical assessment.

Malnutrition

Zinc deficiency has been cited as a cause of plantar hyperkeratosis[28]. The condition itself is usually hereditary (as an autosomal recessive trait) or acquired through malnutrition. Weissman[28] has also presented cases of zinc deficiency occurring in patients with alcoholic cirrhosis of the liver who demonstrated plantar involvement.

Summary

Hyperkeratosis is the most common disorder of the adult foot. In most cases the causes are mechanical in nature and should be managed appropriately. A minority of cases are caused by a range of other conditions. Effective treatment for these requires a firm diagnosis. Where the aetiology is uncertain referral to a specialist should be sought.

For guidance on the use of emollients, please refer to the earlier CPD article on "Emollients: selection and application" in the September 2005 edition of Podiatry Now.

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Case Study 1

A 70 year old woman presented to the clinic with a scaly, symmetrical hyperkeratosis affecting both heels. The condition had been gradually worsening but now was becoming uncomfortable for the patient who enjoyed walking (Figure 4). Her medical history revealed nothing of note. Examination of the hyperkeratosis showed a close relationship to the heel area of the insock of her favourite shoes, which showed a high sheen (Figure 5). It was suspected that the motion of the sole over the insock was leading to inflammation of the skin and the development of the hyperkeratosis. The insole was removed and replaced with a simple cushioning insole. The hyperkeratosis subsided within a few weeks.

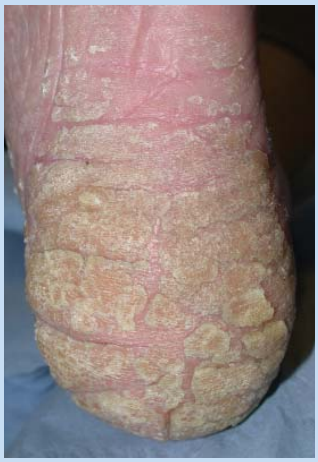

Figure 4

Figure 5

Case Study 2

A 45 year old man presented with hyperkeratosis and fissuring to the plantar surface of the feet. Prior to this, he had had regular debridement and reduction with a Moores disc but this had proven unsatisfactory as the callus would frequently bleed. The patient's history revealed that he had suffered intermittently with eczema elsewhere on the body. Moreover, the hyperkeratosis on the foot was variable and not related to activity levels. On examination, the soles of the feet were hyperkeratotic with a vague erythema and fissuring around the heels. The texture of the hyperkeratosis was light and brittle. A diagnosis of chronic plantar eczema was made and he was treated for 10 days using a potent topical steroid and emollients*.

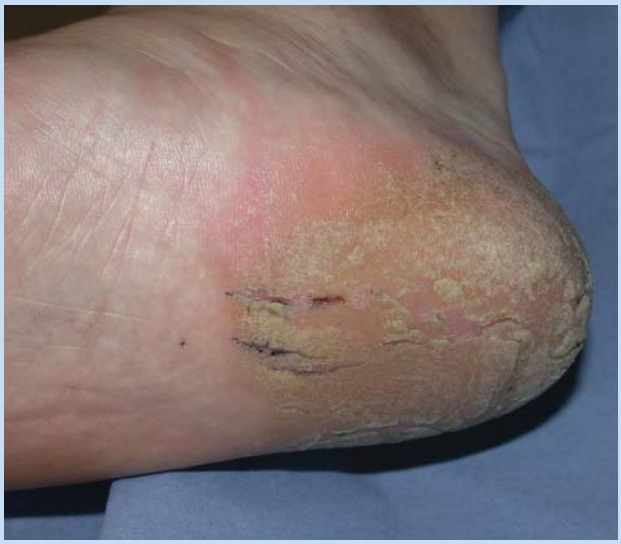

Figure 6

Post-reading activity

Reflection

After reading this CPD article, take a few moments to reflect on its content.

1. How would you define hyperkeratosis?

2. What are the main causes of hyperkeratosis on the feet?

3. What percentage of my own caseload may have hyperkeratosis attributable to causes other than mechanical?

4. Will this article change my practice at all? If so how?

5. How will this impact on the care of my patients / service users?

6. After reading this, have I identified any new CPD needs (for example revision of specific topics, acquisition of new skills etc).

Notes

Key points

Learning outcomes

CPD Series No. 2

Title: Hyperkeratosis: Part 1. Author: Ivan Bristow

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