# STUDIES IN PLANTAR ULCER IN LEPROSY V. The Complications of Plantar Ulcer

## E. W. PRICE, F.R.C.S.E.

# formerly Orthopaedic Surgeon, Leprosy Service, Eastern Nigeria

The complications of plantar ulcer in leprosy are important not only because they often lead to failure of treatment, but also because they may cause permanent damage to the foot. The neuropathic (Charcot) joint is also included in this study because it occurs frequently in feet with plantar ulceration.

The dominant features of complicated ulcer are infection and oedema. The infection may involve not only bone and joint, but also venous and lymphatic channels. Chronic oedema accompanies infection, but it may exist apart from infection as in the oedema of disuse or of derangement of the autonomic system.

It is important to recognise the persistence of oedema, because the condition retards the normal healing processes and can of itself lead to chronic fibrosis of the subcutaneous tissues.

The common complications of plantar ulcer are now described.

# **Subcutaneous Plantar Infection**

The lesion which precedes frank ulceration of the sole is sterile until the skin is broken. When infection occurs—as a result of a crack in the dermis, or frank ulceration—subcutaneous banal infection is inevitable, and resembles the common infections of the palm of the hand. The recognition of infection without ulceration is important in case it is confused with the early sterile stage of the deep plantar necrosis which precedes ulceration in a neuropathic foot. Failure to distinguish the two lesions can lead to incision of a "necrosis blister" in mistake for a pocket of pus, an error which can initiate a train of events ending in bone and joint infection. (Fig. 3.)

In both lesions, there is a localised swelling which is tender to pressure and, as in the case illustrated, there may be superficial cracking of the skin suggestive of a portal of bacterial entry.

Deep necrosis, however, is preceded by several days—or nights of continuous burning pain and heals rapidly with simple rest and elevation of the part. Deep infection is more painful and throbbing than burning; increased local warmth may be detected, and it does not respond to simple rest and elevation without antibiotic therapy. If in doubt, it is wise to rest the foot in an elevated position and use antibiotics. A swelling that persists painfully for 48 hours without improvement is then probably purulent, but it is still better to aspirate for diagnosis than to make a mistaken incision. The aspirated fluid is sterile from a necrosis blister and will show bacteria and leucocytes in cases of infection.

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### **Bone and Joint Infection**

This is the tragedy of plantar ulceration. Once established it may remain incurable long after the leprosy is arrested; every effort should be made to avoid it, or recognize and treat it at the earliest possible moment. Symptoms are often masked by the associated anesthesia and it is wiser to rely on regular foot inspection for diagnosis, than on the patient coming of his own accord to seek treatment.

In the anesthetic foot, the extent of the infection is commonly more widespread than appears clinically and the futility of local metatarsal excision is often confirmed by radiology—which demonstrates wider spread of infection than is suspected at operation.

The site of the initial necrotic lesions before infection occurs is shown in Fig. 1. This lies under a metatarsal head in the forefoot (or under the head of the proximal phalanx of the big toe); midlaterally, it lies under the tuberosity of the fifth metatarsal; and at the heel, under the lateral tuberosity of the calcaneum. The two latter bony points present prominently in the sole when there is weakness of the evertors of the foot.

The risks of pyogenic infection are seen from the diagram:



Oblique section of foot to show relation of joint spaces to sites of plantar ulceration A, B and C represent the common sites of necrosis blister. If ulceration occurs, the underlying bone and joint are exposed to the danger of infection.

The ankle-joint is presented in mirror-image to show how closely the synovial membrane of ankle and talo-navicular joints approach on the medial aspect of the neck of the talus. Only "thin and indefinite capsular fibres" separate the joints (Frazer).

The mid-lateral lesion (B) is seen to be the most dangerous to the foot.

### The forefoot ulcer: (A)

This exposes the metatarso-phalangeal joint and adjacent bones. Spread to adjacent joints is not an early event, but osteomyelitis readily spreads up the metatarsal and may lead to pathological fracture or involvement of the tarso-metatarsal joints.

### The mid-lateral ulcer: (B)

This is the most dangerous of the lesions. It is a risk to both the cubo-metatarsal and the cubo-calcaneal joints. Spread from the cubo-metatarsal readily involves all the tarso-metatarsal joints except the first; then by continuity, the complex surfaces between the navicular and cuneiform bones. There is often disorganisation of the midfoot.

Cubo-calcaneal infection continues across the foot and invades the talo-navicular and anterior talo-calcaneal joints.

This exposes the ankle-joint to danger because of the surprising anatomical fact that the ankle-joint is separated from the base of a mid-lateral plantar ulcer by tissues which barely exceed 5 mm. in total thickness. Frazer (1946) points out that the synovial membranes of ankle and talo-navicular joints are separated on the medial side of the neck of the talus "only by thin and indefinite capsular fibres".

Clinically, there is often non-infective effusion into the anklejoint due to the irritation of adjacent sepsis; the swollen ankle then raises the possibility of a neuropathic joint unless its nature is appreciated.

### The Heel Ulcer: (C)

This involves the calcaneum only, until the later stages of infection; but it is important because the associated decalcification weakens the attachment of the long plantar ligament. Widespread involvement of the calcaneum is inevitably followed by collapse of the arches of the foot.

This disaster is represented clinically by an irregular pad of plantar tissues representing the sole of the foot, and by a new series of bony prominences in the sole over which pressure ulcers may develop. (Fig. 4.)

In collapse of the *lateral longitudinal arch*, these bony knuckles lie on a line passing across the foot from the tuberosity at the base of the 5th metatarsal towards the medial tuberosity of the calcaneum (Fig. 2). If this line is divided into three equal parts, the bony prominences are:

1. The tuberosity of the cuboid.

2. The anterior tubercle, or keel, of the calcaneum.

The resulting plantar ulcers (Fig. 5a) may join to form a linear ulcer passing medially from front to back across the posterior half of the sole (Fig. 5b).

Collapse of the *medial*. *longitudinal arch* indicates a grosser damage to the foot. The bony prominences that may present in the sole are (Fig. 4b):

- 1. The insertion of peroneus longus into the base of the first metatarsal.
- 2. The insertion of peroneus longus into the 1st cuneiform.
- 3. The tuberosity of the navicular.

The clinical lesion is a series of ulcers, or a linear ulcer from the base of the 1st metatarsal to the medial aspect of the heel.

The final stage of tarsal disorganisation is represented by an indeterminate ulceration in the mid-sole (Fig. 5b left foot).

The additional plantar ulcers that may appear as a result of major damage to the bony architecture of the foot are represented in Fig. 2. Note that in extreme cases, there may be a pressure ulcer over the head of the proximal phalanx of the second toe.

Plantar Ulceration in Collapse of the Longitudinal Arches of the Foot

The diagram lists the sites of plantar ulceration which represent collapse of the longitudinal arches as follows:



- 1. Overlying the tuberosity of the cuboid.
- 2. Overlying the anterior tubercle (keel) of the calcaneum.
- 3. Overlying the base of the 1st metatarsal.
- 4. Overlying the medial cuneiform.

5. Overlying the tuberosity of the navicular.

PPH2 (Proximal Phalangeal Head 2) represents the ulcer that sometimes occurs over this bony prominence when the second toe attempts to take over the walking function of the big toe. This occurs when there is failure of the intrinsic musculature of the big toe.

### Phlebo-thrombosis and Chronic Lymphoedema

The patient with a chronically swollen lower leg is a frequent sight in leprosy settlements, and the infrequency with which this crippling complication is treated suggests that its nature is not always recognised. The lesions are disabling and permanent but can



Fig. 3

Infection or Necrosis? The swelling over the 4th metatarsal head may be an infection or a deep

necrosis blister. If a blister, it will heal with simple rest and elevation. If infection, antibiotics and evacuation of pus are needed. The patient did not complain. The lesion subsided with rest and elevation after four days, without an antibiotic. It is a necrosis blister. Ill-advised incision would have risked a chronic ulcer or subcutaneous banal infection.





### FIG. 4. Collapse of the longitudinal arches

(a) In collapse of the lateral arch the abnormally presenting bony points are the tuberosity of the cuboid, and the keel of the calcaneum (anterior tubercle). These lie in a line from the tuberosity on the base of the 5th metatarsal to the lateral tuberosity of the calcaneum.

(b) In collapse of the medial arch, the presenting bony prominences are the base of the 1st metatarsal, the tubercle on the medial cuneiform, and the tuberosity of the navicular.



FIG. 5. Ulceration from collapse of longitudinal arches

5a. Collapse of the lateral arch results in ulcers along a line from the base of the 5th metatarsal to the lateral half of the heel. In this case, the calcaneum is partly destroyed and the ulcers overlie the tuberosity of the cuboid and the keel (anterior tubercle) of the calcaneum.

5b. Right foot: The individual ulcers of the previous illustration may fuse into a linear ulcer representing complete collapse of the lateral longitudinal arch. Left foot: When there is complete disorganisation of the foot, the plantar ulcer is an indefinite lesion over the presenting pad of tissues in the middle of the sole. (See left foot in 5a.)



### ANTERIOR

FIG. 6. The disastrous results of metatarsectomy

The gross deformity of the foot makes the fitting of footwear impossible without further operation; and it will be noted that the ulcer for which the operation was performed is still present. It is suggested that the operation be abandoned in the treatment of chronic plantar ulcer.



LATERAL

be avoided or treated, if the possibility of venous or lymphatic blockade is kept in mind.

The usual cause is neglected septic infection of the foot. Secondary phlebitis or lymphangitis occur, at first acutely or subacutely; but each recurring attack is less obvious clinically until the gross lesion of phlebo-thrombosis or chronic lymphoedema below the knee is established.

*Phlebo-thrombosis* of the foot and lower leg starts in the vicinity of the ulcer and spreads along the deep channels into the calf. The valves are incorporated in the clot, so that when the vein is recanalised (as is usual after a year or so), the venous channels lack valvular support. Chronic venous stasis ensues and the "post-phlebitic syndrome" is established (DeCamp et al. 1952). The acute attack of phlebitis may pass unnoticed, but usually there is pain and swelling of the calf and sole. There is fever. The oedema of the first attack may completely subside, but becomes more permanent with each fresh attack until it hardens into a firm non-pitting swelling of the lower leg.

The skin becomes ill-nourished and indurated, and may be eczematous. An indolent ulcer is not uncommon above the medial malleolus, and must not be mistaken for one which is leprotic in origin. The venous stasis of the sole hinders normal healing processes and predisposes to a subsequent inflammatory phlebitis. Infective emboli are very uncommon.

*Chronic Lymphoedema*, or chronic lymphatic blockade, is an entity distinct from phlebothrombosis and is much less common. During an acute attack, the oedema of the dorsum of the foot is associated with visible lines of tender lymphatic channels.

Repeated attacks produce an increasing induration of the skin and subcutaneous tissues, common to other forms of elephantiasis.

The venous circulation is unimpaired and the healing processes of the sole are relatively unaffected.

Both conditions have been observed during the course of chronic plantar ulceration in leprosy, and the importance of their early recognition and treatment is stressed in order to avoid the crippling effects of permanent lymphatic or venous damage.

The lesions occur in other diseases and are described more fully by Anning (1952), Monro (1952), Gibson et al. (1950), Cannon (1950), Watson (1953) and Ochsner et al. (1952).

### **Chronic Oedema of Disuse**

The lower limb depends on activity, even more than the upper, to maintain lymphatic and venous circulation. A neuropathic foot often leads to an inactive shuffling gait and this is emphasised if there is plantar tenderness. It is possible that nervous involvement of the autonomic system is superadded. The total effect is a tendency to oedema of the foot, and this may be limited to the sole in the early stage. The importance of the condition lies in the decreased resistance to infection and trauma that it encourages; and the care of the neuropathic foot must include the recognition and treatment of disuse oedema.

The lesion will be recognised during routine examination of the feet, but will be missed in the early stages unless the sole is palpated and pitting oedema sought. There are no other early signs, except for slight splaying of the toes. The leprosy worker will be aware that a similar condition is noted on the sole of both feet in cases of lepromatous leprosy, but the slight swelling of the sole and splaying of the toes is not accompanied by pitting oedema.

Recognition of the condition calls for the institution of treatment aimed at increasing the circulation and decreasing the debilitating effect of chronic oedema on the tissues of the sole.

### The Neuropathic (Charcot) Joint

The neuropathic joint of leprosy resembles the lesion seen in diabetes rather than the classical "Charcot joint" of syphilis. In the absence of radiological facilities, its frequency is underestimated, but it should be suspected in every case of anaesthetic leprosy presenting unexplained painless or moderately tender swelling in the tarsometatarsal region or at the ankle-joint. Walking is often unaffected.

Unrecognised and untreated, the condition develops slowly and progressively to disorganisation of the foot.

A neuropathic joint is often associated with plantar ulceration, as in diabetes (Martin 1952). In these cases, it may be difficult in an anaesthetic foot to determine whether a tarsal swelling is due to spreading infection or early neuropathy. At the ankle the difficulty may be to distinguish the lesion from irritation of the ankle-joint in septic mid-lateral ulceration.

In the neuropathic lesion, no signs of inflammation or joint-fluid are present. X-ray shows generalised decalcification and loss of joint-space with fragmentation of the adjacent bone.

New bone formation is minimal, in contrast to the similar lesions in syphilis. The metatarsal atrophies and may show spontaneous fracture. As in diabetes (Martin 1953), the lesion also occurs in the absence of sepsis or any vascular condition.

Those unfamiliar with the condition should consult papers describing the similar lesion in diabetes, Bolen (1956), Bailey et al. (1947), Jacobs (1958). There appears to be no literature concerning its occurrence in leprosy.

### Metatarsectomy

It is not usual to describe surgical intervention as the complication of a lesion, but the occasion is taken to draw attention to the undesirable effects that follow a high proportion of cases subjected to this operation.

In general, partial metatarsectomy is performed in an attempt to achieve healing of a chronic plantar ulcer. The observation of a number of cases that have undergone this treatment makes it doubtful if the mutilation is ever really justified.

The deformity caused (Fig. 6) is often severe and necessitates further surgical correction if footwear is to be fitted. The ulcer for which the operation is performed may not heal, or may recur (as the illustration shows). Not uncommonly, another plantar ulcer appears elsewhere on the foot after the intervention, and even if the ulcer remains healed, the mechanics of the foot are permanently disturbed.

The most convincing argument against metatarsectomy is the knowledge that healing of a chronic ulcer can be achieved by other non-traumatic methods. It is therefore suggested that control of the complications of plantar ulcer will be advanced by the suppression of what is largely a useless and crippling procedure.

### Summary

1. The complications of plantar ulceration are described.

2. It is recalled that plantar ulceration is itself a complication of a previous pressure necrosis of the sole.

3. The serious outcome of several of the complications is described and the importance of early diagnosis and treatment is stressed.

4. Attention is drawn to those complications not commonly treated in leprosy settlements: phlebothrombosis, chronic lymphoedema, disuse oedema, and the neuropathic (Charcot) joint.

5. It is suggested that metatarsectomy be considered an avoidable complication of plantar ulceration.

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