

# Frequency and Localization of Plantar Perforating Ulcers of Leprosy Patients

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This study was made at the Marchoux Institute with the help of R. H. BOISSAN on more than 3,000 leprosy patients, of whom 403 patients had 1,049 perforating plantar ulcers. These patients were under treatment at the Institute or came to the daily clinics of the Leprosy Service.

It is worth while to note that the population of leprosy patients studied is not necessarily representative of leprosy as disseminated throughout the bush, but those afflicted with plantar ulcers are more numerous at the Institute than in any African region, seeing that hospitalization is a necessity for many of them.

We point out that we have adopted for this study the nomenclature used by LECHAT in his report on bony lesions in the Rome Congress of 1956, namely:

- A = heel
- B = lateral border of the foot
- C = base of 2nd, 3rd, 4th and 5th toes
- D = base of the big toe
- E = medial border of the foot
- F = plantar arch

The results of our enquiry are summarized in Table I as to frequency and localization, and percentages in Table II.

## AN ACCOUNT OF THE RESULTS:

### 1. *Frequency of plantar ulcers*

(a) *According to sex* the ulcers are more frequent in the men, 62.6 per cent against 37.4 per cent in women. When one considers the exhausting work of African women and in comparison the three months of work a year by their male companions the results seem astonishing.

In detail<sup>1</sup>, the women did not wear shoes, nor were they pre-immunized better than the men in their sphere.

(b) *Frequency according to age*: In the thousands of leprosy patients examined we have only three times encountered plantar ulcers in those of less than 20 years of age. Also it is possible to state that perforating plantar ulcers are an exclusive complication of the adult, or those patients who are more than 20 years of age. Neuritis has been incriminated in the pathology of plantar ulcers, and in 81.4 per cent of patients nerve lesions are associated. But vascular, and sympathetic nervous pathology, are



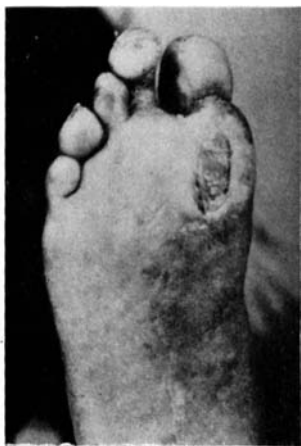
A — Heel



B — Lateral border of the foot



C — Base of fourth toe



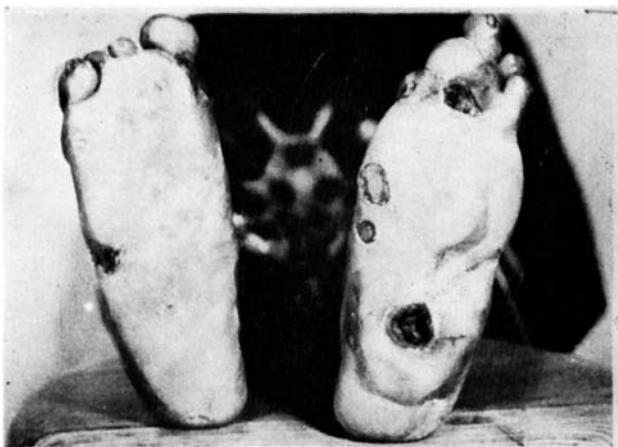
D — Base of big toe



E — Ulcers of pad of toes



F — Plantar arch



B — Lateral border of the foot

equally as important as nerve damage in producing plantar ulcers, even though they supervene slowly in leprosy.

TABLE I  
**Frequency and Localization**

<i>Type</i>		<i>Total</i>	<i>Males</i>	<i>Females</i>
Patients		403	255	148
Plantar ulcers		1,049	657	392
A		126	73	53
B		88	58	30
C		408	254	154
D		399	261	138
E		18	8	10
F		10	3	7
Forefoot	C + D	807	515	292
Mid tarsus	B + E + F	116	69	47
Rear tarsus	A	126	73	53
Victim of	1 plantar ulcer	136	94	42
" "	2 " ulcers	86	53	33
" "	3 " "	77	44	33
" "	4 " "	50	30	20
" "	5 " "	31	17	14
" "	6 " "	14	12	2
" "	7 " "	4	2	2
" "	8 " "	2	2	0
" "	9 " "	3	2	1

TABLE II  
**Percentages**

<i>Type of Plantar Ulcers</i>	<i>Total</i>	<i>Males</i>	<i>Females</i>
A	12.2	11.2	13.9
B	8.3	8.8	7.8
C	38.8	38.5	38.6
D	38.1	39.7	35.4
E	1.7	1.3	2.6
F	0.9	0.5	1.7
Forefoot C + D	76.8	78.3	74.4
Mid tarsus B + E + F	11.0	10.6	11.7
Rear tarsus A	12.2	11.1	13.9

(c) *Frequency according to the form of leprosy*: Here also the results are very definite. In our 403 patients who had plantar ulcers we found 381 tuberculoid or indeterminate patients, and only 22 lepromatous, pointing to the conclusion that plantar ulcers are almost exclusively a complication of the first two types.

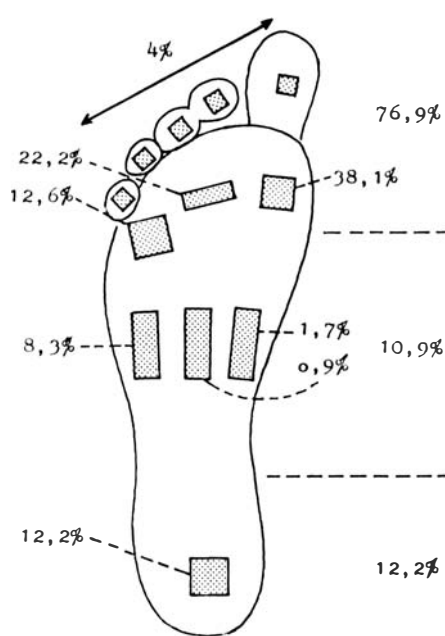
## 2. *Sites of Plantar Ulcers*

(a) *Ulcers of the base of the toes* are the most frequent. JEANSELME said 'the perforating plantar ulcer of leprosy shows this peculiarity, that it occupies the forefoot 'almost exclusively', and more recently E. W. PRICE said 'the

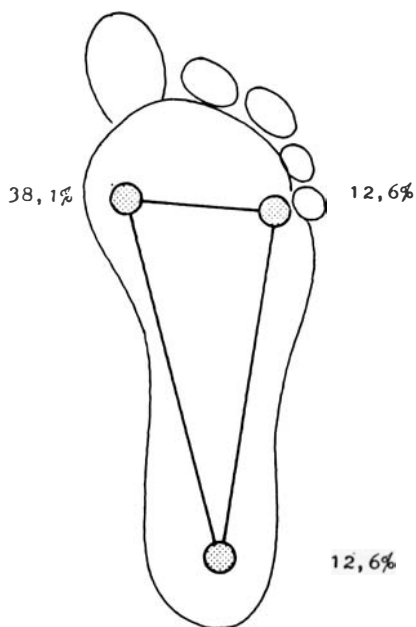
most typical character of these ulcerations is their predominance on the forefoot'. In our data we found 807 plantar ulcers of this kind out of a total of 1,049 patients, that is 76.8 per cent of ulcer patients. As regards to site, sex plays an unimportant role (78.3 per cent in males and 74.4 per cent in females).

In fact the complete list of 807 plantar ulcers should be divided into two fairly equal parts, the big toe, and the base of all the other digits, for we found 38.1 per cent of the big toe and 38.8 per cent of all the others. It should also be noted that in our series, ulcers of toes 2, 3, 4, 5, most often involved the base of the fifth (12.6 per cent out of 38.8 per cent). Further it should be noted that almost all these plantar ulcers responded well to the protection in the sole of the distal head of the respective metatarsal bone. The role attributed to static compression seems very solidly based. While the ulcers occur over the metatarsal heads they especially attack the far extremity of the toes in that little plateau which is really a prolongation of the sole and is particularly traumatized when the foot is raised in the course of walking.

(b) *Ulcers of the midtarsus*: We are grouping together the plantar ulcers of the medial and lateral borders of the foot and those very rare ulcers of the plantar arch. In this group we have only met with 11 per cent of patients. Those of the lateral border of the foot only represent 8.3 per cent of the total number of ulcers. These take up a special shape because of their position with their long axis parallel to the main axis of the foot reaching often 8–10 cm. Ulcers on the medial border of the foot are very



Localization of Plantar Ulcer



Dynamic Pressure Triangle of the Sole

rare and only reach 1.7 per cent, and show the same features as ulcers of the lateral border in the plantar arch. Logically, as a result of its concave form the plantar arch seems to be out of reach of numerous spontaneous traumatic or surgical mutilations, and the central part seems to be the part most attacked by ulcers (0.9 per cent and this occurs equally in males and females).

(c) *Ulcers of the heel* which JEANSELME considers rare and some of which are communicated with a concomitant syphylitic affection, have been met with by us with 12.2 per cent of the cases (those of the midtarsus we have found in 11 per cent). Up to the present time sex seemed to have played a negligible role, but we have found that ulcers of the heel are more frequent in the females (11 per cent men and 14 per cent women). It seems that we should incriminate an ordinary custom in Africa, viz. that the carrying of heavy objects on the head and more so the carrying of children on the back, so that the lumbar arch is increased and the distribution of weight is such that the centre of gravity is situated well behind the normal.

### 3. *Localization of Plantar Ulcer in Connection with the Biomechanics of Gait*

(a) *Pressure triangle on the sole*: The pressures are equally distributed in halves on the hindfoot, and in the forefoot are divided into five parts, one on the base of each toe. We have found that a dynamic footprint of a healthy subject shows that the foot is remarkably flat when applied to a flat surface.

If the foot is strongly pressed on the sole we afterwards see the silhouette of the heel which is imprinted entire. Then the silhouette elongates in the long direction on the lateral border of the foot from which we see the bases of the five toes and still further forward the imprint of the extremities of the toes separated from the rest of the picture by the flexion of the phalanges. We can test this experience on pressing very lightly the foot on the sole. Behind, there is the heel part of the sole then always the line of the lateral border and in front the line of the bases of the toes at the level of the fifth running to the base of the big toe. Thus the first damage to the sole begins to operate when the triangle goes into operation of the base of the big toe, the base of the fifth toe and the heel. This is what we call the dynamic pressure triangle of the sole and its reality is shown by the percentages of ulcers which we have found to occur as follows:

Base of the big toe	..	38.1 per cent
Base of the fifth toe	..	12.6 per cent
Base of the heel	..	12.2 per cent

thus making a total of 62.9 per cent.

(b) *Application of the foot to the sole during walking*: We cannot do better than apply step by step the explanations given by E. W. PRICE. The gait essentially consists of the rolling of the foot on itself (the walking roll) in which the heel first raises itself from the sole, and pressure is made on all

the proximal extremities of the metatarsals. When these are raised they are replaced by the distal heads. The final push is given all the extremities of the toes. This is the line of the metatarso-phalangeal articulations in the active cooperation of which the most important is flexion. Muscular and tenderness intervention is reduced to its most simple degree. It is in the dynamic pressure triangle of the sole where two thirds (62.9 per cent) of plantar ulcers occur.

#### SUMMARY

1. In a population of leprosy patients the occurrence of plantar ulcers is about 12 per cent.
2. Males are always more subject to ulcers than females (62.6 per cent males, 27.4 per cent females).
3. Adults alone are affected, and those under 20 years of age, never.
4. Plantar ulcers are peculiar to tuberculoid and indeterminate leprosy patients.
5. Three quarters of plantar ulcers occur on the forefoot.
6. The most numerous of the plantar ulcers are those of the big toe (38.1 per cent). The others are:
 

Those of the bases of toes 2, 3 and 4	..	22.2 per cent
Those of the base of the fifth toe	..	12.6 per cent
Those of the heel	..	12.6 per cent
Those of the lateral border of the foot	..	8.3 per cent
Those of the medial border of the foot	..	1.7 per cent
Those of the plantar arch	..	0.9 per cent
7. Sex intervenes little in the frequency of distribution of plantar ulcers except in the heel which is more attacked in the female than in the male.
8. The first damage in the sole attacks by choice three sites, namely the base of the big toe, the base of the fifth toe, and the heel, and we ascribe this to the dynamic pressure triangle of the sole.

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