Foot Deformities in Leprosy—A Survey in the Solomon Islands

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(1) A survey was carried out of 1000 lower limbs of leprosy patients. (2) All deformities, except palsies, were more prevalent in patients with lepromatous leprosy. (3) Plantar ulcers occurred in about 26% of feet. (4) There was little difference between the sexes in the incidence of ulceration. (5) The type of terrain had no influence on the incidence of ulceration. (6) The picture of deformity in the Solomon Islands Melanesians is similar to that in Australian Melanesians. (7) Foot care is important in the treatment of leprosy in the Solomon Islands.

Introduction

The Solomon Islands comprise a scattered archipelago stretching approximately 900 miles (1450 km) in a south-easterly direction from New Guinea. The six major islands (Choiseul, New Georgia, Santa Isabel, Guadalcanal, Malaita, and San Cristobal) form a central double chain of large islands. All these islands have a mountainous spine which on one side falls steeply to the sea, and on the other side drops through a series of foothills to the coast. The largest of them has an area of over 2000 miles² (5180 km²). For the most part, the islands are covered with dense tropical rain forest, and the thin coastal strips are bounded in many places by coral reefs.

Two distinct types of Melanesian people live in the central islands, the "bush" people and the "coast" people. The "bush" people are nomadic, seldom come to the coast, live in small groups, and pursue a shifting cultivation. The "coast" people live in larger villages, some of which are built on artificial islands on the reefs. They subsist by fishing and cultivating gardens on the plains along the coast.

Surrounding the central mass of islands are widely dispersed atolls which are inhabited by Polynesians, ethnically quite different from the Melanesians. They live by fishing and by the growing of coconuts for consumption, as well as for the copra. The total population of the islands is 161,000, seven-eighths of whom are Melanesians.

The first reference to leprosy in these islands—though indirect—is a report by Guppy (1887) who, as surgeon on a visiting naval ship, described painless ulcers on the soles of the feet, often accompanied by gross deformity. He did not, however, associate the ulcers he described with leprosy.

The Annual Report of the Solomon Islands' Medical Department for the year 1922 contains the first definite reference to leprosy. The only accurate and extensive survey of leprosy in the Solomon Islands was that carried out by Ross

Innes (1938), who estimated the prevalence of leprosy then to be about 10 per 1000 of the population—a level probably unchanged today.

Selection and Examination of Patients

The patients in the present survey were seen on Malaita in the Government District Hospital at Auki, at a Mission Hospital with a leprosarium at Fauabu, a leprosy village at Ombafau, and a Mission Station at Takwa. Other patients were seen on Guadalcanal at the Government Leprosarium at Tetere; they were all Melanesians, except for 2 Polynesians. Since nearly all patients suffering from leprosy in the Solomon Islands are referred to one of these centres, the general picture obtained is probably accurate. Patients were examined, unselected, as they presented themselves; the first 500 seen form the subject of this survey.

A thorough examination was personally carried out of each lower limb from the knee distally. First, the lateral popliteal and posterior tibial nerves were palpated for abnormalities, and any evidence of drop-foot or claw toes noted. Anaesthesia of the sole of the foot was next determined by reference testing, as described by Ross (1964). Finally, the patient was asked to stand on a sheet of paper on which each foot was outlined, any ulcers or deformities being subsequently recorded on the print.

Of the 500 patients, 292 were male and 208 female. Details were noted of both feet of each person examined. The classification used is that recommended by the World Health Organization Technical Report (1960) (see Table 1, B1-B5). The site of plantar ulcers is indicated according to the nomenclature of Lechat (Rome Congress, 1956). This is: A Heel; B Lateral border of the foot; C Base of 2nd, 3rd, 4th and 5th toes; D Base of the great toe; E Medial border of the foot; F Plantar arch.

The breakdown of figures in this survey is shown in Appendix I.

Results of the Survey

Table 1 shows the percentage of each deformity in relation to the type of leprosy.

ANAESTHESIA—B1

Demonstration of loss of sensation proved difficult, owing to problems of language and comprehension. Nearly half (43.9%) of the feet seen were hypo-aesthetic. In males with lepromatous leprosy 71.3% of feet showed some loss of sensation, whereas females with tuberculoid leprosy showed the lowest incidence, i.e. 26.2%.

TROPHIC ULCERATION (PAST OR PRESENT)—B2

(a) *Incidence.* Approximately one quarter (25.9%) of the feet were ulcerated. The largest incidence was among males with lepromatous leprosy (44%), and the lowest among females with tuberculoid leprosy (17.5%).

(b) *Malignant change.* Of 445 ulcers, only one was malignant, an infiltrating squamous-cell carcinoma. A below-the-knee amputation was performed and the patient remains well after 5 years. The rarity of malignant change is well documented (Job and Riedel, 1964).

(c) *Terrain.* Possible differences in the prevalence of ulceration between "bush" and "coast" people were investigated, since the terrains are different.

TABLE 1

Types of leprosy	Lepromatous	Borderline	Tuberculoid	Total
Distribution of types	29.8%	8.4%	61.8%	100%
Anaesthesia—B1	69.1%	53.6%	30.4%	43.9%
Trophic ulceration past or present—B2	44.0%	23.8%	17.5%	25.9%
Paralysis (foot-drop or claw toes)—B3	12.7%	13.1%	11.8%	12.2%
Partial absorption of foot—B4	13.4%	9.5%	6.5%	8.8%
Gross absorption of foot—B5	6.0%	4.8%	3.1%	4.4%
Abnormal lateral popliteal nerves to palpation	17.1%	11.9%	7.9%	11.0%
Abnormal post-tibial nerves to palpation	8.1%	4.8%	3.1%	4.7%

However, no difference was found; 26.4% of "coast" feet were ulcerated, compared with 25.5% of "bush" feet.

(d) *Sex*. As the women, particularly on the island of Malaita, do most of the manual work, including the carrying of heavy loads (see Fig. 1), ulceration might be expected to be more frequent in them. This was not so: 29.1% of men's feet were ulcerated, against 21.4% in women.

(e) *Site of trophic ulcers*. Table 2 shows the distribution of ulcers in the sole of each foot. This subject is well covered by Price (1959a, b, c). As expected, the majority (65.7%) of the ulcers were in the fore-foot; 17.5% were in the mid-tarsus, and 16.8% on the heel. The comparatively large number of ulcers in the mid-tarsal area may be due to the fact that in many patients the sole had become convex (or navicular) because of deformity of bones and joints associated with severe nerve damage. This deformity, well described by Harris and Brand (1966), leads to the maximum pressure being borne by a small area in the middle of the foot when the subject is standing or walking. In women, 20% of ulcers were found at this site, an observation probably to be correlated with the fact that women habitually carry heavy loads.

(f) *Age*. 3 children had plantar ulcers.

(g) *Race*. Of the 2 Polynesians included in the survey, one of the 4 feet showed dropping, plantar anaesthesia, and ulceration.

TABLE 2
Site of plantar ulcers

A	Heel	16.8%		
B	Lateral border	10.6%		
C	Base of 2nd–5th toes	35.1%	Fore-foot	65.7%
D	Base of great toe	30.6%	Mid-foot	17.5%
E	Median border	2.0%	Heel	16.8%
F	Plantar arch	4.9%

Fig. 1. Malaita woman carrying a load of firewood.

(h) *Number of ulcers per foot.* 14.5% had one ulcer, 6.2% had 2, 3.3% had 3, and 1.8% had 4 or more. In some cases, the single ulcer observed was so large that it may have resulted from the coalescence of more than one.

PARALYSIS (FOOT-DROP AND CLAW TOES)—B3

Drop-foot was found in 8.7% of feet, and clawing of the toes in 3.5%. There was very little difference between the various types of leprosy, i.e. lepromatous 12.7%, borderline 13.1% and tuberculoid 11.8%. There was a predominance of drop-foot in males. In 12 of the lower limbs the only abnormality noted was foot-drop. Since several of the patients had also had poliomyelitis, the determination of the cause of the palsy in the individual was sometimes difficult, or even impossible.

PARTIAL ABSORPTION OF THE FOOT (UP TO ONE-THIRD OF SURFACE AREA OF THE SOLE OF THE FOOT)—B4

Only a small proportion of feet showed this phenomenon. The highest rate (14.3%) was among patients with lepromatous leprosy, and the lowest among those with tuberculoid leprosy (5.0%). There was a slight predominance in males.

GROSS ABSORPTION (MORE THAN ONE-THIRD OF THE FOOT LOST)—B5

The incidence of gross absorption of feet (4.4%) was half that of partial absorption in this small series. Gross deformities were more common in females (5.9%) than in males (3.6%).

ENLARGED LATERAL POPLITEAL NERVES

An attempt was made to assess the relationship between enlarged lateral popliteal nerves and foot damage. 11% of nerves were found on palpation to be enlarged in the popliteal fossa and around the neck of the fibula. Foot damage was commonest among the patients with lepromatous leprosy (17.1%), and least common among those with tuberculoid leprosy (7.9%). No obvious relation was found between enlarged lateral popliteal nerves and foot damage—a finding in agreement with those of Rao *et al.* (1970) in India.

ENLARGED POSTERIOR TIBIAL NERVES

The posterior tibial nerve at the ankle was found to be enlarged in 4.7% of feet, with a marked predominance among males, i.e. 7.2% : 1.4%. The incidence was highest in patients with lepromatous leprosy and least in those with tuberculoid leprosy. There was thus no obvious relation between enlarged posterior tibial nerves and damage to the feet—a finding confirmatory of that reported by Rao *et al.* (1970).

Surveys in Other Countries

A comparison of our findings with those of Hargrave (1963) in pure-blooded Aborigines in the Northern Territory of Australia, is shown in Table 3. The great majority of Solomon Islanders and all Australian Aborigines are Melanesians in origin, and among them the overall picture of foot deformity appears to be similar, with patients with lepromatous leprosy being at greatest risk.

TABLE 3

Comparison of deformity between Melanesians in the Solomon Islands and Australian Aborigines

Place	No. of patients	% with foot deformity	% of patients with lepromatous leprosy with foot deformity	% of patients with tuberculoid leprosy with foot deformity	% of patients with borderline leprosy with foot deformity
Northern Territory, Australia	300	53%	60%	54.7%	30.2%
Solomon Islands	500	54.8%	75.3%	44.2%	31.1%

Mallac (1966), in a survey in Northern Burma, found a higher incidence of deformity among patients with tuberculoid leprosy than in those with the lepromatous type. Susman (1963) in the Gambia, found that approximately 25% of patients had deformities of their feet. This figure is over 50% in the Solomon

Islands. Languillon (1964), reporting an extensive survey in Mali, concluded that approximately 12% of patients suffered from trophic ulceration, and that the incidence was low in lepromatous leprosy. In Solomon Island Melanesians, 25.9% of feet were ulcerated.

The findings of Martinez Dominguez *et al.* (1966) in Northern Nigeria, Cameroons, and Thailand are compared with the figures from the Solomon Islands in Table 4. Deformities of the lower limb vary between 30.4% in Northern Nigeria and 59.4% in Thailand. The figure in the Solomon Islands is 45.1%. Palsies are rare in Northern Nigeria, relatively common in Thailand and the Solomon Islands. Again, in Thailand and Northern Nigeria deformities are much more common among males, whereas in the Solomon Islands and the Cameroons there is very little sex difference.

TABLE 4
Comparison of lower limb deformities in four countries

Place	No. of feet	Yes	Disability No	%	WHO Grading				
					B1	B2	B3	B4	B5
Northern Nigeria	1664	506	1158	30.4	329	144	35	61	24
Cameroons	1560	748	812	48.0	99	270	97	261	136
Thailand	922	547	445	59.4	287	82	140	106	41
Solomon Islands	1000	451	549	45.1	439	259	122	88	44

Conclusion

The pattern of foot deformity varies greatly in different parts of the world.

Foot deformity due to nerve damage in leprosy is a major problem in the Solomon Islands. Nearly 55% of patients have some kind of deformity, and 45.1% of all limbs seen were affected. Of more serious import is the fact that 25.9% of feet were ulcerated. The patients at the greatest risk are those with lepromatous leprosy. In the Solomon Islands, education in foot-care and the wearing of sandals by patients whose feet are anaesthetic are essential features of the campaign against leprosy.

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Appendix 1

Analysis of the abnormal findings in 1000 lower limbs

Sexes	Lepromatous		Uncharacteristic		Tuberculoid		Total	
	M	F	M	F	M	F	292	208
No. of patients	101	48	21	21	170	139	500	
No. of feet	202	96	42	42	340	278	1000	
Anaesthesia B ₁	144	62	27	18	115	73	439	
Trophic ulceration B ₂	92	39	9	11	69	39	259	
Palsies B ₃	28	10	7	4	48	25	122	
Partial absorption B ₄	29	11	4	4	26	14	88	
Gross absorption B ₅	7	11	2	3	12	9	44	
Abnormal lat. pop. nerves	40	11	6	4	29	20	110	
Abnormal post. tib nerves	22	2	4	0	15	4	47	

Appendix II

Distribution of ulcers between coastal and bush people and between males and females

	Total no. of feet	Anaesthetic feet	Ulcerated feet
"Coast" feet	466	205	123
"Bush" feet	534	234	136
Male feet	584	288	170
Female feet	416	151	89

Total patients with anaesthesia 261

Anaesthetic-feet *Bilateral 178*
Unilateral 83