# The Severely Deformed Foot in Leprosy

## Causation, Prevention and Treatment

### Ernest Fritschi<sup>1</sup>

Neglect of the anesthetic feet of leprosy patients leads to slow destruction of the foot, usually with few dramatic episodes. The drama continues either in the search for adequate footwear to bring about a happy ending, or until somebody tires of conservatism and the curtain falls with amputation of the limb. In many countries amputation is the logical and desirable treatment for most of the feet that will be discussed in this paper. Volstein (7), in a paper presented recently, has made a very careful scrutiny of the cost of providing below-knee artificial limbs in India. He worked the cost out to be 450 Indian rupees (approximately 65 American dollars). This price included the artificial limb itself and the cost of hospitalization of the patient for fitting and physiotherapy. The price does not appear high until one remembers that in India the average per capita income (1969) is Rs 360. per annum. The limb, therefore, represents the average total income of one person for one year and three months. The story does not end there. An artificial limb, like any other article of footwear, has a limited life. It requires repairs and probably complete replacement in two or three years, even if it has been used carefully. But the type of patient whose feet get into bad enough condition to warrant the consideration of ablation, is not the type to look after his artificial limb carefully.

In countries with a high standard of living, finance does not constitute an argument, because the cost of retaining the deformed limb, in terms of loss of manhours and restriction of activities, would far exceed the cost of an artificial limb. But in the countries in which such advanced deformity is seen, the economic argument is incontrovertible. There is one additional factor which anywhere argues for conservatism. It is always infinitely preferable for a patient to have a foot of his own which, in an emergency, he can immediately use without having to find it and buckle it on. It should be emphasized that conservative treatment does not obviate the necessity to provide the patient with good and sometimes elaborate footwear. A review of the long-term results of subtalar fusions made for leprosy patients recently, revealed a large percentage of failure of union, and several subsequent amputations (4). The argument, therefore, between conservative treatment and ablation remains open. The cases presented here are all cases in which the advisability of amputation was considered, and one case (Fig. 1) in which it was performed. The indications for amputation in this case were complete bony dissociation of the forefoot from the hind foot by the intervening lateral side ulcer, freedom of the patient from other deformity or sign of leprosy in any other part of the body, and circumstances such that he could afford to provide himself with an artificial limb and maintain it. It was considered, therefore, that the patient has a better chance of returning to society as an amputee rather than as an ex-leprosy patient.

#### CLINICAL MATERIAL

All the patients presented here were inpatients in the Pusat Rehabilitasi Sitanala, Tangerang, Indonesia. Many of them had been admitted more than ten years previously; two were admitted during the past six months. All the cases selected showed an architectural breakdown of the foot. The series does not include extremities with simple paralysis only.

The cases were investigated on the basis of a prepared proforma in which the history of anesthesia, ulceration, and onset of deformity was considered. In some of the

<sup>&</sup>lt;sup>1</sup> E. Fritschi, M.B.B.S., D.Orth., F.R.C.S. (Edin.), The Leprosy Mission, Djakarta, Indonesia.

cases X-ray photographs were taken. Most of these were disappointing and difficult to interpret on account of extreme overlap of the bones of the tarsus, especially in fixed varus feet, three of which displayed as much as 90° of varus. An attempt has been made to reconstruct from available data the possible natural history of such deformity, and to suggest preventive measures and lines of management.

#### FINDINGS

A series of 19 patients were examined. Four of these had bilateral involvement of the feet; so the total number of feet examined was 23, comprised of 13 left and ten right. There was no correlation between age and extent of destruction. The youngest patient in the series was 19 years old, and the oldest 65. The age distribution is shown below:

Years	No. of Patients
Below 30	5
31-40	5
41-50	4
Over 51	5

Sex. The sex distribution was nine women and ten men. This actually indicates a higher prevalence among women than among men since the group was selected from among inpatients of the hospital, made up of about 150 men and 60 women.

Sensation. Sensation was lost in the foot, including plantar and dorsal aspects in all cases. The modality tested was crude sensation in response to the pressure of a blunt pin. Some of the patients had sensory loss even above the knees, and some down to the ankles on the medial side. The group was too small to attempt any correlation of sensory defect pattern with the extent or severity of the damage.

Muscular paralysis. Out of the 23 feet examined, only five showed a paralysis of the muscles supplied by the common peroneal nerve. One other gave a history of an episode of paralysis some years before, of which there was now no evidence. The muscles tested were: extensor digitorum longus, tibialis anterior, peroneus longus



FIG. 1. Patient with anesthesia confined to his right foot and lower leg. The extent of the deformity, and the absence of other stigmata of leprosy constituted the indications for amputation.

and brevis, triceps surae and tibialis posterior. It was not possible in most cases to grade the power of the muscles, but with two exceptions, in women, there was no difficulty in testing for activity. In both of these cases the action of the peroneals was not clear because the area was extensively scarred (Fig. 2). Isolated paralysis of the superficial peroneal nerve is very rare, however, and it seems a more likely explanation that these tendons had been completely destroyed by the chronic ulceration of the lateral side of the foot.

History of ulceration. All the cases gave a history of ulceration at some time. In many the ulcers were at more than one site. Twenty-one feet had a history of long-standing ulceration on the lateral border preceding the deformity. Of the remaining two, one had a rocker-bottom foot with ulceration under the arch on the medial side (Fig. 3), and the other was the

619



FIG. 2. Plantar view of the feet of the patient with fixed varus. Note the extreme scarring, which involved all the tissues down to the bone and rendered assessment of the peroneal muscles impossible.

only case in the series with a history of sudden onset. On examination this was clearly a case of Pott's fracture of the ankle joint with subsequent disintegration of the talus. Fourteen feet had a history of ulceration under the metatarsal heads, and four had had ulcers under the heel.

Nature of deformity. Eighteen of the feet showed a predominant varus deformity, of which seven had also a very marked equinus. In one of these the equinus was the most obvious deformity (Fig. 4). In many of the others there was marked shortening of the foot, with an equinus of the hindfoot demonstrated by backward pro-



FIG. 4. Severe degree of fixed equinus with slight varus and outer border destruction of the foot.

trusion of the heel, although the actual lower surface of the foot was almost at right angles to the axis of the foot. This condition has been termed a concealed equinus (Fig. 5). In three cases the varus was 90°. The patient was walking on the side of the foot with the sole facing medially, and the most dependent bone structure was the lateral malleolus and the remains of the lower surface of the talus (Fig. 6). One foot showed swelling, ankle joint effusion, and instability suggesting Charcot's joint (Fig. 7). All the other feet were reduced in size and had fixed deformity.

Two feet showed a valgus deformity which had occurred after an operation in 1952. Before the operation the patient stated that his feet were turned inward. The details of the operation were not available. Both feet had active musculature.



FIG. 3. Rocker-bottom foot of mild degree. Note the scar of ulceration under the arch.



FIG. 5. Concealed equinus deformity with almost complete destruction of the forefoot.



FIG. 6. Right angle varus deformity. Patients with this deformity walk on the remains of the talus and the lateral malleolus.

There was no effusion or synovial hypertrophy, but both were unstable.

#### DISCUSSION

Several points in these findings may throw some light on the natural history, and therefore offer some hope of prevention of these severe deformities. The three factors responsible for the changes appear to be anesthesia, trauma and infection.

Anesthesia. This must be regarded as the fundamental predisposing factor in the genesis of gross deformities. Almost without question this factor operates more in a negative than in a positive way, i.e., by preventing the natural reflexes that facilitate the healing processes rather than by exerting positive influences which militate against these processes.

It is perhaps profitable here to draw attention to the condition of Charcot's joint, which, like the joints described here, is largely caused by sensory paralysis. The classic description of Charcot's joint is erosion of cartilage, distension of joint space, with hypertrophic synovium and synovial fluid, and a variable amount of new bone formation. Consequently the clinical presentation is a swollen joint with marked instability and gross internal derangement. There is only one joint in this series of cases which could fit into this category (Fig. 7). Two others, the valgus cases referred to above, showed instability, but without synovial hypertrophy or effusion and with re-

duction rather than distension of the joint space. The other condition that gives rise to such gross damage is familial radicular sensory neuropathy. There is one case in this series in which this diagnosis cannot be ruled out, i.e., the one shown in Fig. 1, for which amputation was done. In my experience the damage in these cases is greater than in the case of leprosy. This may possibly be because there is usually not a complete loss of all sensation in many of the leprosy cases, whereas in radicular sensory neuropathy presumably the congenital lesion is complete. In this series, with exception of the case shown in Fig. 7, all had a relatively stable deformity, sometimes a fibrous ankylosis, and almost always a complete obliteration of at least the anterior talo-calcaneal joint.

Trauma. One case displayed the typical deformity of an ununited Pott's fracture, which was confirmed by X-ray examination. It also showed fragmentation of the talus, which was striking and probably related to the fact that the patient had been walking on the fractured ankle for over one month since the accident, with only very little pain. In all other cases there was no history of trauma and the onset was insidious. It is probable, however, that the tendency to varus may be caused by trauma, which, because it is painless, is not recognized by the patient. Harris and Brand  $(^2)$  have called attention to this



FIG. 7. Early varus with involvement also of the ankle joint with effusion. Aspiration drew out infected synovial fluid. There was instability. This case was the nearest approach to a Charcot joint in this series.





condition of unrecognized bony injury. It is well known that sprains involving ligamentous tears frequently cause painful, unstable ankles, especially in middle-aged women. There seems to be a possibility that one of the early phenomena may be rupture of the calcaneo-fibular ligament. This could cause a slight inversion of the joint at the ankle, thus making an increased tendency toward the otherwise not too common lateral border ulcer. In support of this hypothesis is the tilt of the talus, which can be seen radiographically on forced inversion in some of these feet. Infection. Price (<sup>6</sup>) considered this to be the most likely primary factor. The vulnerability of the peroneus tendons is seen from Figures 8 and 9. Once these are damaged by tenosynovitis, there is a predisposition to inversion of the foot, and this renders the calcaneo-fibular ligament particularly liable to damage. Probably the last to go are the interosseous ligaments, as a result of the infective process. In the milder cases at operation the anterior talo-calcaneal joint is almost invariably seen to be destroyed and frequently, also, the ligaments are unrecognizable, the whole subtalar area, with the



FIG. 9. The subtalar joint after removal of the talus, seen from above.

exception of the posterior joint, being converted into a fibrous ankylosis in the subluxated position. This is probably due to pyogenic arthritis. In the normal joint pyogenic arthritis usually gives rise to bony ankylosis, but in the absence of the immobility conferred on the joint by pain, it is easy to believe that only a fibrous union can follow. It is certain that all three factors are. present in every case, with perhaps differences in their relative importance.

#### PREVENTION

This study suggests that the lateral border ulcer in the anesthetic foot is a completely regular feature in the history of disintegration, and should therefore be taken most seriously. Feet which show ulcers at this site should be radiologically examined for lateral ligament laxity by taking an antero-posterior view of the ankle joint in forced inversion. Should this reveal instability, it is the author's opinion that a subtalar stabilizing procedure is indicated. The ulcer can usually be healed without difficulty. If there is copious synovial discharge a window plaster can be applied and the patient put on a course of broad spectrum antibiotic; complete healing usually occurs in six to eight weeks.

Whether or not a stabilization is performed, the lateral border ulcer calls for a molded sole shoe, and in some cases a below-knee brace to restrict subtalar mobility.

#### TREATMENT

Not many attempts at reconstruction of the severely deformed foot in leprosy have been recorded. Lennox (5) described some, and Hart et al. (3) offer a modified Pirigoff amputation. These cases fortunately are not common. We have been interested in them for many years and so far no long term follow-up has been available. Reference to Karat's follow-up has already been made. In view of her findings, viz., that many of the deformities had recurred and many had been subsequently amputated, we have felt it necessary to increase our period of immobilization from the three months in vogue in the earlier years to not less than six months. We have also started using compression clamps in all cases. These clamps are applied for four weeks. during which they are periodically tightened by one or two turns. After this, a walking plaster is applied with a Bohler iron so as to encourage use of the limb and improvement of the disuse atrophy and osteoporosis so often seen at operation. After the patient is released from the plaster he is provided with a short leg brace preventing inversion and eversion and limiting plantar flexion to 90°. The shoe is made with a high mold and rigid sole and roll (1). These principles have been applied for the last four years or so, and the earlier cases are still stable and satisfactory. Bony fusion has not always been obtained, but, with the correction of the deformity and the subsequent protection of the foot as outlined, we believe that this is not essential. In the present series only eight feet so far have been operated. These have been dealt with more or less in accordance with the plan set forth in the accompanying diagrams (Figs. 10-13).



FIG. 10. Mild degree of equinus. Lambrinudi arthrodesis, slightly modified.



FIG. 11. Severe degree of equinus. Subtotal talectomy with calcaneo-navicular fusion as well. Heel cord lengthening and skin graft are sometimes required.

#### CONCLUSION

At what are we aiming in carrying out these salvage procedures? The struggle against recurrent ulceration of the anesthetic foot is a losing game. The maximum we can hope for is continuation of the status quo. In the author's opinion a five year ulcer-free survival period makes this surgery worth while. The whole period from commencement of the healing of the ulcer to provision of the final brace occupies about one year, but there is no reason why at least half of that time could not be spent at home in plaster if the patient's home circumstances allow it.



FIG. 12. Varus foot with subluxation of the calcaneus. Reduction and subtalar arthrodesis.



FIG. 13. Rocker-bottom foot. Triple arthrodesis with "keystone" graft. (If there is enough bone available an attempt may be made at anterior fusion of the talus with navicular remnant and calcaneus with cuboid or metatarsus V remnant. This may be reinforced by a dorsal longitudinal inlay cortical graft.)

#### SUMMARY

Twenty-three severely deformed feet which showed fixed equinus, varus, and rocker-bottom deformities were studied. The relative importance of the factors of anesthesia, trauma, and infection in the etiology of these deformities is discussed. Suggestions regarding the prevention and treatment of the conditions are made.

Acknowledgements. My thanks are due to the Department of Health, Republic of Indonesia, for permitting me to undertake this study, to the Leprosy Mission for financial support, and to Dr. Dharmavam, Director of the Pusat Rehabilitasi Sitanala, for his ready cooperation. They are due also to Miss Christine Shepheard, M.C.S.P., for assisting me in the examination of the feet and their assessment, to Mr. L. McCowan and Mr. Adrian Irwin for their help with the photographs, and to Miss Katharine Johnston for typing the manuscript.

#### REFERENCES

- GIRLING, J., HAMEED, M. A. AND SELVA-PANDIAN, A. J. Experimental moulded shoes and lasts. Leprosy Rev. 37 (1966) 103-107.
- HARRIS, J. R. AND BRAND, P. W. Patterns of disintegration of the tarsus in the anaesthetic foot. J. Bone and Jt. Surgery 48B (1966) 4-16.
- 3. HART, R. J., WILLIAMS, H. W. AND SCOTT,

G. R. A new approach to the problems of grossly deformed feet. Leprosy Rev. 40 (1969) 59-62.

- 4. KARAT, S. Personal communication (1965).
- LENNOX, W. M. The surgical management of foot deformities in leprosy. Leprosy Rev. 36 (1965) 27-34.
- PRICE, E. Care of the Feet. Chapter in Leprosy in Theory and Practice, R. G. Cochrane and T. F. Davey, eds. John Wright and Sons, Bristol (1964), 519.
- 7. VOLSTEIN. Paper presented at the Southern Regional Conference of the Leprosy Mission, Salur, October 1969.