

Follow-up of Application of Plaster-of-Paris Casts for Non-infected Plantar Ulcers in Field Conditions*

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This investigation of the frequency of recurrence of plantar ulcer after the removal of a plaster cast showed that while the overall recurrence rate was 40%, over half (55%) recurred within the first 3 months after removal and 72% did so within 6 months. The recurrence rate was higher (45%) in deformed feet than in "normal" feet (36%). The importance of preventing development of a first ulcer is emphasized and the prophylactic effect of wearing microcellular rubber shoes is discussed.

INTRODUCTION

In the Danish Leprosy Control Project at Pogiri, Andhra Pradesh, the routine treatment of non-infected plantar ulcers consists of the application of below-knee walking plaster-casts, which are applied in the field as well as in hospital. These patients are followed up at regular intervals as far as is feasible in field conditions, and preliminary results of 549 cases were presented at the Ninth International Leprosy Congress, London, 1968, and at the Eleventh All India Leprosy Workers' Conference, New Delhi (see Cap *et al.*, 1968).

Since then, information about 313 additional cases has become available. The total number of ulcers found to be cured at removal of the plaster-cast, and followed up after at least one year, amounts at present to 862. The results are presented in this paper. The terminology and classification used are in accordance with the recommendations of the WHO Expert Committee.

MATERIAL AND METHODS

When this information was collected, some 27,300 patients were registered for treatment in the project, and 8016 had already been released from control. Out of a total of 35,316 patients

under treatment or under observation, 9391 (26.5%) have anaesthetic feet, and 2196 are suffering from plantar ulcers, i.e. 7.2% of the total number of patients or 23.4% of the patients with anaesthetic feet.

One of the objectives of the physiotherapy department is to prevent the development of plantar ulcers in patients with anaesthetic feet, through health education, and by providing them with simple nail-less microcellular rubber (MCR) shoes.

A plaster-cast is applied for non-infected plantar ulcers, but patients with infected ulcers are admitted to hospital for a few days and a P.O.P. (plaster-of-Paris) cast applied as soon as the infection has subsided. It is not known how many of the existing plantar ulcers in the project are non-infected and suitable for treatment with a plaster-cast.

The healing rate lies between 80 and 85%. An ulcer is considered healed only when it is completely closed. When the ulcer is persistent, the failure is mainly due to the fact that patients themselves remove the cast shortly after application. Sometimes it happens that the plaster-cast is damaged in such a way that it becomes useless.

In the 862 cases which could be followed-up, and which form the subject of this study, the ulcer was found to be cured on removal of the

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plaster. It was intended to re-examine all those patients after a 12-month period, but this was not possible in field conditions, because it would take several months before all clinics could be visited by the mobile physiotherapy team. It sometimes happened that the patient did not attend the programme although he was requested to do so, or he may have been absent from his village at the time. For these reasons the great majority of the patients were seen between 18 and 24 months, the average period being 19 months. In a very few cases, the period between removal of P.O.P. and follow-up was more than 3 years.

There was no difference in the recurrence rate in relation to the duration of the period of observation (see Table 1).

TABLE 1

Recurrence of plantar ulcers in relation to the period of observation after removal of the P.O.P.

<i>Period of observation in months</i>	<i>Recurrence</i>		<i>Total</i>	
	<i>Number</i>	<i>%</i>	<i>Number</i>	<i>%</i>
12-18 months	175	42.4	413	47.9
18-24 months	116	40.0	290	33.6
24-32 months	42	36.8	114	13.2
32-36 months	5	31.2	16	1.9
37-42 months	4	33.3	12	1.4
42 months and over	6	35.3	17	2.0
Total	348	40.4	862	100.0

RESULTS

General

As in the previous report (Cap *et al.*, 1968) the recurrence rate is 40%, 348 plantar ulcers having recurred out of the total group of 862. The additional group of 313 patients with ulcers did not change the recurrence rate in any way.

As can be seen in Tables 2 and 3, there is no difference in the recurrence rate between the sexes, nor in relation to the form of leprosy; no patients with the indeterminate type of leprosy were treated for plantar ulcers with a plaster-cast, and the group under review therefore contains only those with lepromatous or tuberculoid leprosy.

TABLE 2

Recurrence of plantar ulcer after P.O.P. in relation to sex

<i>Sex</i>	<i>Recurrence</i>		<i>Total</i>	
	<i>Number</i>	<i>%</i>	<i>Number</i>	<i>%</i>
Male	229	39.7	577	66.9
Female	119	41.8	285	33.1
Total	348	40.4	862	100.0

TABLE 3

Recurrence of plantar ulcers in relation to the classification

<i>Classification</i>	<i>Recurrence</i>		<i>Total</i>	
	<i>Number</i>	<i>%</i>	<i>Number</i>	<i>%</i>
Lepromatous	96	42.3	227	26.3
Tuberculoid	252	39.7	635	73.7
Indeterminate	—	—	—	—
Total	348	40.4	862	100.0

Recurrence in relation to the period of time after removal

Information about the period of time which elapsed between removal of the plaster-cast and recurrence of the ulcer was obtained by questioning the patient and also from the notes on the treatment cards which were kept by the clinic-workers.

Table 4 shows that out of 862 healed ulcers, 193 or 22.3% recurred within 3 months and 29.2% within 6 months after removal of the P.O.P. From then onwards, the recurrence rate increases more slowly.

TABLE 4

Period of time between removal of P.O.P. and recurrence of plantar ulcer (862 cases)

<i>Period after removal in months</i>	<i>Recurrence</i>	
	<i>Number</i>	<i>%</i>
0-3 months	193	22.3
3-6 months	252	29.2
6-9 months	281	32.6
9-12 months	322	37.4
12 months and over	348	40.4

TABLE 5

Period of time between removal of P.O.P. and recurrence of plantar ulcer

<i>Period after removal in months</i>	<i>Recurrence Number</i>	<i>%</i>
0-3 months	193	55.4
3-6 months	59	17.0
6-9 months	29	8.3
9-12 months	41	11.8
12 months and over	26	7.5
Total	348	100.0

Considering only the recurred ulcers, it can be seen from Table 5 that of 348 recurred ulcers more than 55.4% did so within the first 3 months after removal of the plaster. Nearly 72.4% had recurred before 6 months had elapsed. Only in 26 cases (7.5%) did the ulcer recur after having been closed for more than 12 months.

The first few months immediately following the removal of the plaster-cast thus seem to be decisive in the possible recurrence of plantar ulcers.

Duration of the ulcers

In our previous study the impression was gained that the recurrence rate was higher in long-standing ulcers than in ulcers of short duration; out of 549 ulcers, 123 were reported to have been present less than one year before treatment. Of the latter, 39 or 31.7% recurred, while in the 426 long-standing ulcers 180 or 42.3% recurred.

In the present study the difference has flattened out; thus, 78 or 35.0% of the 223 ulcers with a duration of less than one year recurred, while of the 633 long-standing ulcers, 267 or 42.2% recurred. The difference is statistically not significant. (See Table 6.)

Results in normal feet and in deformed feet

In our previous study it was observed that of 295 patients with normal feet the ulcer recurred in 105 or 35.6%, and that of the 254 patients with deformed feet, 114 or 44.9% suffered a recurrence. The opinion was then

TABLE 6

Recurrence of plantar ulcer in relation to its duration previous to the application of P.O.P.

<i>Duration of plantar ulcer</i>	<i>Recurrence Number</i>	<i>%</i>	<i>Total</i>
0-3 months	30	36.1	83
3-6 months	25	32.1	78
6-12 months	23	37.1	62
Less than 1 year	78	35.0	223
1 year	104	39.0	267
2-6 years	120	42.1	285
6-10 years	35	52.2	67
10 years and over	8	57.1	14
More than 1 year	267	42.2	633
Total	345	40.3	856*

*Information about duration of the plantar ulcer is not available for 6 patients: the ulcer recurred in 3 and did not recur in the 3 remaining.

expressed that the difference in the recurrence rate would increase still more if only those deformities which change the weight-bearing area were taken into consideration.

An attempt was therefore made to clarify this point and the present group was split into 3 sub-groups (see Table 7). This table shows that in 354 patients with otherwise normal feet, 128 or 36.2% had a recurrence of the ulcer.

The group of 189 patients with absorption of the feet is not very homogeneous and is therefore kept separately. It included patients with slight absorption of the toes, as well as patients with gross absorption and subsequent changes in the

TABLE 7

Recurrence of plantar ulcers after P.O.P. application in patients with deformed feet, and in patients with otherwise normal feet

	<i>Recurrence Number</i>	<i>%</i>	<i>Total Number</i>	<i>%</i>
Normal feet	128	36.2	354	41.2
Feet with absorption	75	39.7	189	21.9
Deformed feet	145	45.7	317	36.9
Total	348	40.5	860*	100.0

*Information about status of foot missing in 2 cases.

weight-bearing area; here 75 or 39.7% of them had recurrent ulcer. By "deformed feet" is mainly meant changes in the weight-bearing area due to previous bone involvement, and also drop-foot and combined deformities. Out of this group of 317 patients the ulcer recurred in 145 or 45.7%.

It is obvious that with a more detailed and more scientifically reliable classification of the deformities, the percentage of recurrences in feet with a deformed weight-bearing area would still increase.

Recurrence and site of the ulcers

The recurrence rate is highest in feet with multiple ulcers (see Table 8). The great majority of these feet are deformed. Out of 139 patients with multiple ulcers, 73 or 52.5% recurred. In the group of 718 patients with single ulcers, the recurrence rate was 38.1%.

Ulcers under the calcaneus recurred more frequently (45.5%), followed closely by ulcers under the 1st metatarsal head (42.1%). Then come the ulcers under the other metatarsal heads and the great toe (36%), and the lowest recurrence rate was observed in ulcers under the base of the 5th metatarsal bone (24.3%). (See Table 8.)

TABLE 8

Recurrence of plantar ulcers in relation to the site

<i>Site</i>	<i>Recurrence</i>		<i>Total</i>	
	<i>Number</i>	<i>%</i>	<i>Number</i>	<i>%</i>
<i>Single ulcers</i>				
Calcaneus	40	45.5	88	10.3
1st metatarsal head	64	42.1	152	17.7
5th metatarsal head	24	36.4	66	7.7
2nd, 3rd and 4th metatarsal head	88	36.2	243	28.4
Great toe	44	36.1	122	14.2
Base of 5th metatarsal	9	24.3	37	4.3
Other	5	50.0	10	1.2
Single ulcers	274	38.1	718	83.8
Multiple ulcers	73	52.5	139	16.2
Total	347	40.5	857*	100.0

*No information available about the site of the plantar ulcer in 5 patients: in 1 the ulcer recurred and in 4 it did not recur.

"Slippery slope"

Information was obtained from 837 patients about the existence of previous ulcers. The plaster-cast was applied for the first ulcer in 243 patients. It recurred in only 46 or 18.9% of them, as compared with a recurrence rate of 40.1% for the whole group. It is notable that where there had been a previous ulcer which left scar tissue after healing, the recurrence rate becomes more than twice as high. In a group of 217 patients who had had one ulcer previously, it recurred in 98 or 45.2%. From then onwards the recurrence rate increases slowly from 48.5%, when there were 2 previous ulcers, to 52.6% when there were more than 2 previous ulcers (see Table 9). These findings clearly show that the first ulcer is the most dangerous and should be avoided at all costs.

An attempt was then made to find out whether the ulcers which recurred almost immediately after removal of the plaster-cast (see p. 185) did so in patients with multiple

TABLE 9

Recurrence of plantar ulcers in relation to the previous ulcers (slippery slope)

	<i>Recurrence</i>		<i>Total</i>	
	<i>Number</i>	<i>%</i>	<i>Number</i>	<i>%</i>
I	46	18.9	243	29.0
II	98	45.2	217	25.9
III	82	48.5	169	20.2
IV-VIII	110	52.6	209	24.9
Total	336	40.1	837*	100.0

*Information about scars of previous ulcers is not available for 24 patients, 12 without recurrence of the ulcer and 12 with recurred ulcer.

- I : The P.O.P. was applied for the first ulcer to occur, there having been no ulcer previously.
- II : The P.O.P. was applied for the second ulcer, the first being cured with or without plaster-cast.
- III : The P.O.P. was applied for the third ulcer, the first and second being cured with or without plaster-cast.
- IV-VIII : Previous to the application of the plaster-cast, there had been 2 to 7 ulcers, which had been cured with or without application of P.O.P.

TABLE 10
Distribution on "slippery slope" of patients whose ulcer recurred within 3 months after removal of the plaster-cast

<i>Number of ulcers</i>	<i>Number of patients</i>	<i>%</i>
I	58	31.2
II	50	26.9
III	38	20.4
IV-VIII	40	21.5
Total	186*	100.0

*Information about scars of previous ulcers is not available for 7 cases.

previous ulcers and extensive scar tissue. However, a comparison between Tables 9 and 10 shows that the proportion of patients for whom a plaster-cast was applied for 1, 2 or 3, or more previous ulcers, is the same in the total group as in the group in which the ulcer recurred within 3 months after removal.

FOOTWEAR

One of the points of the health education programme of the physiotherapy department is to convince patients with anaesthetic feet to wear MCR shoes.

The shoes are provided by the Project and cost about 10 rupees, but the patients can buy them from us for 3 rupees, which is about the same price as they pay for cheap, locally made shoes.

As a rule MCR shoes are not given free, so as to make sure that there is some personal motivation on the part of the patients.

TABLE 11
Number of patients with anaesthetic feet and having MCR shoes

	<i>Number of patients with anaesthetic feet</i>	<i>Number with shoes</i>		
		<i>1968</i>	<i>1969</i>	<i>%</i>
		<i>Number</i>	<i>Number</i>	
Without ulcers	7,195	365	866	12.0
With ulcers	2,196	376	684	31.1
Total	9,391	741	1,450	15.4

At present 1450 patients are wearing MCR shoes, or 15.4% of patients with anaesthesia of the feet, with or without ulcers (see Table 11). It is much easier to convince patients who are suffering from plantar ulcers to wear these shoes, and 31.1% of them have been provided with protective footwear.

Of the 7195 patients with anaesthesia of the feet without plantar ulcers, only 866 (or 12%) have MCR shoes. It is, however, very encouraging to see that the number of patients in this category who are wearing MCR shoes has risen from 365 to 866, an increase of 135%. In the group of patients who had already had ulcers previously, the numbers rose from 376 to 684, or by 82%. The relative higher increase of shoe-wearing in the former group gives an indication of the influence of the health-education programme.

It is not possible in field conditions to have a measurement of the efficacy of footwear in the prevention of plantar ulcers, but data have been collected about the recurrence of plantar ulcers after P.O.P. in relation to the use of shoes.

It is rather surprising to find, as Table 12 shows, that there is little difference in the recurrence rate between patients who have MCR shoes and those who have not. Several explanations can be put forward. In this part of India footwear is uncommon among the agricultural population and lower social strata. The great majority of our patients belong to these categories, and although they are taught that they have to wear their shoes "24 hours a day", it is not at all certain that they in fact do so.

TABLE 12
Recurrence of plantar ulcer after P.O.P. application, in patients with and without MCR shoes

<i>Number of patients</i>	<i>Recurrence</i>		<i>Total</i>	
	<i>Number</i>	<i>%</i>	<i>Number</i>	<i>%</i>
Patients with shoes	175	43.3	404	46.8
Patients without shoes	173	37.7	458	53.2
Total	348	40.4	862	100.0

In other words, there may be a difference between "having shoes" and "wearing shoes".

The standard MCR shoes, when worn regularly, last for 4 to 6 months, but it sometimes happens that the patient neglects to have them repaired, or fails to replace them when they are beyond repair. Another reason is that patients who have had several ulcers previous to the P.O.P. application, and also those with deformed feet, are more willing to wear shoes. Out of 243 patients for whom a plaster-cast was applied for the first ulcer, 103 or 42.4% are

wearing shoes, whereas 123 or 58.8% of the 209 patients who have had more than 3 ulcers previously have MCR shoes (see Table 13). Again, 149 patients (41.8%) with normal feet wear shoes, against 180 (56.8%) of the 370 patients with deformed feet (see Table 14). Both groups represent the great majority of the patients for whom a plaster-cast has been applied, and their plantar ulcers are prone to recur whatever kind of footwear they are provided with; the footwear supplied by the Centre is unavoidably of a simple and standardized type, which may not be entirely suitable for such feet.

TABLE 13
Number of patients having MCR shoes in relation to the number of previous ulcers

	Number of patients	Patients wearing MCR shoes		Total	
		Number	%	Number	%
I	243	21	20.4	103	42.4
II	217	45	45.0	100	46.0
III	169	40	51.2	78	46.1
IV-VIII	209	69	56.2	123	58.8
Total	837	175	43.3	404	48.2

TABLE 14
Number of patients with normal and deformed feet, having MCR shoes

	Number of patients	Number of patients having MCR shoes	
		Number	%
Normal feet	354	149	42.1
Feet with absorption	189	75	40.2
Deformed feet	317	180	56.8
Total	860*	404	47.0

*Information missing about 2 patients.

SUMMARY AND CONCLUSIONS

Over an average period of 19 months after removal of a plaster-cast for non-infected plantar ulcer, it was found that the ulcer had recurred in 348 or 40.4% of 862 patients whose ulcer had been healed at the time of removal of the plaster.

The first 6 months after removal of the plaster is the most dangerous period for recurrence of plantar ulcers: 72.4% of all recurrences took place during this period, and 55.4% occurred during the first 3 months after removal. No relationship was observed between the recurrence rate and sex, or classification and duration of the plantar ulcer previous to treatment.

The recurrence rate was higher (45.7%) in 317 patients with deformed feet than in 354 patients with "normal" feet (36.2%). The recurrence rate is also related to the site of the ulcer. The most important factor seems to be the presence of scar tissue due to previous

TABLE 15
Recurrence rate in patients with normal and deformed feet in relation to shoes

	No.	With shoes		No.	Without shoes		Total number of patients		
		Recurred	%		Recurred	%	No.	Recurred	%
Normal feet	149	59	39.6	205	69	33.6	354	128	36.2
Feet with absorption	75	31	41.4	114	44	38.6	189	75	39.7
Deformed feet	180	85	47.2	137	60	43.8	317	145	45.7
Total	404	175	43.3	456	173	37.9	860	348	40.4

TABLE 16

Patients with P.O.P. application for ulcer under 5th metatarsal head in relation to drop-foot

	<i>Recurred</i>	<i>Not recurred</i>	<i>Total</i>
Patients with drop-foot	6	14	20
Patients without drop-foot	18	28	46
Total	24	42	66

TABLE 17

Patients with P.O.P. application for ulcer under the base of 5th metatarsal bone in relation to drop-foot

	<i>Recurred</i>	<i>Not recurred</i>	<i>Total</i>
Patients with drop-foot	3	2	5
Patients without drop-foot	6	26	32
Total	9	28	37

ulcers. Of a group of 243 patients for whom the plaster-cast was applied for the first ulcer, the ulcer recurred in only 45 (18.9%). This clearly shows the absolute necessity of directing the greater part of our activities towards the prevention of the first ulcer, through health education, teaching patients with anaesthetic feet how to take care of them, and to persuade them to wear nail-less microcellular rubber shoes, of which simple standardized models are provided by the Project.

At present 1450 patients are wearing MCR shoes, or only 15.4% of those who ought to use protective footwear. It is encouraging to observe that the number of shoe-wearing patients who have anaesthetic feet but no plantar ulcer has increased in one year from 365 to 866. The number of patients in this group who are wearing shoes has increased proportionally more than in the group of patients with plantar ulcers. It represents at present 12% of all patients (7195) with anaesthetic feet without plantar ulcer. It looks as if the health-education programme is slowly catching up in the prevention and treatment of plantar ulcers, and that gradually more and more patients are reached at the appropriate period, that is, *before* the ulcer develops.

In the Project no data are available concerning the value of protective footwear in the prevention of plantar ulcers.

The data presented with regard to the recurrence of plantar ulcers and the wearing of footwear are not very encouraging; the recurrence rate is the same in patients with shoes as in patients without shoes. But these figures may be misleading, since proportionally more patients with deformed feet and multiple previous and present plantar ulcers are wearing shoes; in these cases recurrence of the ulcer is very frequent and it is questionable whether the standardized type of shoes they are provided with do give full protection.

It is also not known how regularly the shoes are worn, not only because most people in the area are accustomed to walk bare-footed, but also because several social, economic, and even religious factors are not in favour of constant wearing of shoes. The health-education programme is being directed along these lines.

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