# Deformity in the Reactive Phases in Leprosy

Aetiology and Physiotherapeutic Management

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Various authors have reported on some of the deformities that occur in the reactive phases of leprosy, and have stressed the value of physiotherapy in the prevention and correction of these deformities. Muir (1962) considered the use of suitable, graded physical exercise together with proper nutrition in the prevention of lepra Cochrane (1964) emphasised the reaction. necessity for adequate physiotherapeutic care during the reactive phases of the disease. Ramanujam et al. (1964) pointed out the importance of physical treatments for severe, acute neuritis, acute nerve palsies and 'reaction hands'. Brand (1964) and Namasivayan (1965) described the damage to hands during lepra reaction and suggested physiotherapeutic measures of prevention. Furness et al. (1967) studied the mechanism of deformity in the upper extremity during the reactive phases and outlined the rationale of physical therapy for its prevention and correction. Karat et al. (1967) in describing a rheumatoid-arthritis-like syndrome in association with erythema nodosum leprosum (ENL) have briefly mentioned the physical measures used.

This paper attempts to study the aetiology of deformity occurring during the reactive phases of lepromatous leprosy. It also presents the comprehensive physiotherapeutic management used to prevent, minimise and correct deformity in this period.

### MATERIAL AND METHODS

Forty-two consecutive patients with leprom-

atous leprosy who were admitted to the Schieffelin Leprosy Research Sanatorium for treatment during the reactive phases of the disease are reviewed in this study: 36 of these patients had from 2 to 10 episodes of reaction and 6 patients from 10 to 20 episodes.

Four-hourly temperature records were made. X-rays of the hards and feet were taken during and after each reactive phase. Manual muscle tests and strength-duration curves and sensory maps were used to assess peripheral nerve integrity. Oedema was recorded by water displacement tests.

# COMPLICATIONS

The reactive phase in lepromatous leprosy may disappear in a few days or may recur on and off for years. The damage may be extensive, involving skin, nerve, muscle, bone, joints and lymph nodes. Table 1 shows the complications

TABLE 1 Complications observed in 42 patients during reactive phases

			No. of		-
Complication	ıs		Patients	%	
Erythema Nodosum	Lepro	osum			
(ENL)			42	100	
Raised temperature			42	100	
Peripheral oedema			41	97	
Lymphadenitis			40	95	
Nerve involvement			28	67	
Joint involvement			21	50	
Muscle involvement			20	48	
Bone involvement			18	43	

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relevant to this study. All patients in this group were ill, with a high temperature and general malaise.

Among the complications occurring in the skin are the characteristic ENL lesions, the necrotising forms of ENL, subcutaneous nodules and an acute inflammaton of the skin and subcutaneous ti sue, 'en plaque', down to the deep fascia known as leprous panniculitis. Tables 2 and 3 show the distribution of the necrotising forms of ENL and leprous panniculitis in these patients.

#### TABLE 2

Distribution of necrotising forms of ENL in 42 patients

Sites involved			Ne	%	
Face				15	36
Trunk				14	33
Upper ex	stremity			17	40
Lower ex	tremity			15	36

TABLE 3

Distribution of Leprous Panniculitis in 42 patients

Sites involved		No. of Patients		%	
Face				2	5
Trunk		2.2		3	7
Upper ex	stremity			11	26
Lower ex	tremity			11	26

Peripheral oedema (97%) was a common complication among these patients (Table 1). Table 4 shows the distribution of oedema in the limbs. Oedema of the feet was present in 41 patients (97%), and oedema of the hands in 32 patients (76%).

	TABLE 4		
Distribution	of oedema	in 42	patients

Sites in	Sites involved No. of P			o. of Patients	%
Hands				32	76
Feet				41	97
Forearm		• •		10	24
Leg				22	52

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Table 5 records painful neuritis. Twenty-seven patients (64%) showed involvement of the ulnar nerve, and 10 patients (24%) had neuritis of the lateral popliteal and posterior tibial nerves. Only in 9 patients (21%) was a median neuritis recorded, and in one patient (2%) a radial neuritis.

TABLE 5 Nerve involvement (neuritis) in 42 patients

Nerves involved		$N_{i}$	%		
Ulnar				27	64
Median				9	21
Radial	10.			1	2
Lateral p	opliteal		2.2	10	24
Posterior	tibial			10	24

The complications found in bone were osteoporosis and periosteitis. Periosteitis occurred most frequently in the tibia (26%) while osteoporosis was recorded in 43% of hands and 33% of the feet studied (Table 6).

TABLE 6

	Osteo porosis		Periosteitis	
Bones involved	No.	%	No.	%
Small bones of the hand	18	43		2
Small bories of the feet	14	33	1	$^{2}$
Tibia	1	2	11	26

Pain, effusion and limitation of movement were the 3 complications studied in the joints. All the joints of the upper and lower extremeties were included in the study. The results are shown in Table 7.

TABLE 7 Joint involvement in 42 patients

Joint	Pain		Effusion		Limitatin o Movement	
involved	No.	%	No.	%	No.	%
Shoulder	9	21	_	_	5	12
Elbow	22	52	1	2	11	26
Wrist	25	60	5	12	9	21
Proximal inter phalangeal	?-					
joint	25	60	10	24	13	31
Hips	8	19			2	5
Knees	24	51	9	21	5	12
Ankle	<b>28</b>	67	12	29	8	19

Table 8 records the muscle involvement in the upper and lower extremities in this group of patients. Atrophy of muscles was the most common complication observed. Pain and an occasional myositis were also found to occur.

TABLE 8 Muscle involvement in 42 patients

Sites	Atro	Atrophy		Pain		sitis
involved	No.	%	No.	%	No.	%
Arm	24	57	9	21	3	7
Forearm	23	55	10	23	4	10
Hand	14	33	4	10	2	5
Thigh	20	48	8	19	3	7
Leg	17	40	4	10		
Foot	2	5	2	5		

# OBSERVATIONS

In the course of a reactive phase, the patient may experience a combination of pain in the joints, the nerves and the bones, together with muscle spasm, and usually assumes an immobile posture in the flexed position (Furness et al., 1967). The bones of such a patient tend to become osteoporotic. Leprous panniculitis and the necrotising forms of ENL when occurring over the limbs heal with scar tissue, which forms adhesions between skin, tendons and muscles, resulting in limitation of movements (Tables 2 and 3). Panniculitis was observed in the upper and lower extremities of 11 patients (26%) and necrotising ENL in the upper extremities of 17 patients (40%) and the lower extremities of 15 patients (36%). An occasional myositis was found to occur over the triceps, the origins of the flexor and extensor muscles of the forearm, the abductor digiti minimi and the first dorsal interosseous muscle in the hand. Myositis in the lower extremity was noted occasionally in the quadriceps and near the region of the iliotibial band (Table 8). There seems to be a relation between the appearance of panniculitis in an area and the presence of underlying myositis, both being distributed over similar regions of the body. Effusion of the joints, especially of the knees (21%), ankles (29%) and wrists (12%) caused stiffness and limitation of movement (Table 7). Oedema due to venous and lymph stasis contributed to considerable damage in the hands and feet (Table 4). Painful neuritis caused considerable discomfort, and repeated bouts of reaction sometimes resulted in paralysis. A generalised muscular atrophy occurred occasionally (Table 8). This atrophy resulted from various causes, such as general debility, prolonged periods of inactivity in bed, and muscle spasm due to pain in the joints.

Specific deformities were noticed in the joints of the upper and lower extremities. An adduction deformity was sometimes seen in the shoulder joint due either to panniculitis and necrotising ENL over the scapula and shoulder region, or painful axillary lymphadenitis, or to faulty posture during the acute phase. A flexion contracture of the elbow tended to occur in the presence of oedema, panniculitis or necrotising ENL. The elbow was also sometimes held in a flexed position because of a painful ulnar neuritis. Both the 'intrinsic plus' (swan neck) and 'intrinsic minus' (claw) deformities were seen in the 'stasis hand' without intrinsic paralysis. However, a true ulnar or median paralysis was sometimes recorded.

In the lower extremity, deformity of the knees resulted from hamstring contracture and/or effusion into the joint (Karat et al., 1967). Mobility of the patella was reduced, and extension of the knee was thereby made more difficult especially when the quadriceps muscle was atrophied. Marked atrophy of the quadriceps resulted not only from scarring of a panniculitis or myositis, but also from disuse following pain and consequential inhibition of movement. Ankle deformities commonly developed during the acute phase when the ill patient allowed the feet to drop. This resulted in a tendo Achillis contracture and limitation of dorsiflexion. Other foot deformities included stasis foot with hammer toes, and claw toes due to paralysis of the posterior tibial nerve. Varying degrees of contracture of the flexor hallucis longus and, to a lesser extent of the flexor digitorum longus, observed in 9 patients, were considered to be due to scarring and contracture of these muscles following the



Fig. 1

Foot where oedema had subsided. Shows flexion deformity of great toe due probably to contracture of flexor hallucis longus.

localisation of oedematous fluid behind the ankle, in the vicinity of the lowest fibres of these muscles (Fig. 1). The tendency to contracture increased when the feet were allowed to drop.

#### MANAGEMENT

Acute phase: The aim of treatment in the acute phase is threefold—the relief of symptoms, the improvement of the patient's general health, and the prevention of deformity. Since there is usually an associated constitutional disturbance, systemic measures are important. The patients at the Schieffelin Leprosy Research Sanatorium are put to bed rest, and specific anti-leprosy treatment is stopped. Adequate intake of fluids is ensured. Mild sedatives are given together with appropriate anti-inflammatory drugs. Antimonials are the sheet anchor of treatment in most patients. Steroids are not given except in very severe and refractory cases.

Bed rest should not be continued any longer than necessary and detailed attention must be given to the posture of the patient while in bed. To combat venous stasis the foot of the bed is raised (about 9 inches). The shoulder is held in semi-abduction, the elbow in 100 degrees flexion, the forearm midway between pronation and supination, and the hand in a functional position. The whole arm is raised on pillows. In the lower extremity, the hip is held in a position of 20 degrees of flexion, slight abduction and without rotation, the knee in almost complete extension and the ankle is flexed at a right angle. A padded board may be used at the end of the bed to prevent dropping of the feet. When necrotising ENL is present, a cradle is placed over the legs and feet.

Splints are used at this stage for patients who, because of extreme pain, are unable to maintain correct posture in bed. These splints should be comfortable and allow for increased swelling yet prevent movement. Their function is to protect and immobilise the inflamed tissues and to preserve a movable and functionally useful joint. Splints also help to rest the inflamed nerves and minimise nerve damage. Gutter splints made of plaster of Paris or alkathene are used, being cuffed at intervals. In the lower extremity, they extend from below the gluteal fold to the toes and keep the limb in a functional position (Fig. 2). In the upper extremity they extend from below the axilla to the tips of the fingers, all joints being held in a functional position. Special care is taken to maintain the metacarpophalangeal joints of the fingers in flexion.

Once the acute phase is passed, mobilisation is immediately encouraged. The anti-inflammatory drug is gradually withdrawn over a period of 2 to 6 weeks and (depending on the clinical state) an appropriate anti-leprosy drug is introduced.

When the patient is comfortable and the limbs are adequately splinted, attention may be turned to the restoration of joint function. Function is maintained during the acute stage of the disease by gentle local joint movements for a short period each day. These movements are



\$Fig. 2\$ Padded alka<br/>thene splint cuffed to the limb to maintain functional position.

done so as not to cause pain. The most effective approach to daily movements is the 'assisted active' exercise for the large joints, which eliminates the risk of strain for the patient. Movements of the hands and feet help to clear the oedema; this clearance was recorded by water displacement measurements whenever possible. When the daily range of movement is completed the limb is returned to the splint. Isometric contraction of muscles may also be employed while the limbs are splinted, to reduce oedema and prevent muscle atrophy. Whatever method is employed, the patient's exercise tolerance is noted. Any increase in pain or spasm for more than an hour after the session indicates an excessive amount of exercise, which is reduced at the next treatment period.

*Phase of recovery:* When the acute phase has subsided (as shown by the subsidence of ENL and a superficial desquamation of the skin) active measures of rehabilitation are instituted.

The 3 main aims of treatment in this stage are: the maintenance of general health, the prevention of renewed exacerbation, and the correction of residual deformity. This is the transition period between recumbency and gentle cautious movement, progressive weight-bearing and active exercises. If splints were used, they may now be discontinued during the day and worn only at night. Walking with manual assistance or between parallel bars is instituted as early as possible. Particular attention is paid to strengthening the postural muscles. Group exercises may be conducted in the wards every day. In this series proprioceptive neuromuscular facilitation techniques were usefully employed to increase the range of movement in the joints and to increase muscular power.

#### LOCAL PHYSIOTHERAPEUTIC MEASURES

Stiff joints: When there is residual stiffness in the large joints such as the shoulder, elbow, wrist, knee and ankle, the 'hold-relax' technique of proprioceptive neuromuscular facilitation may be used. The joint is taken to the point where further movement is limited by tension or pain. Having made sure that the position is pain-free, the physiotherapist asks the patient to 'hold' while he applies maximal resistance to the antagonistic muscles. The isometric contraction is held in order to obtain build-up of excitation, then the patient is told to relax. Time is allowed for relaxation to take place, and then an attempt is made to move in the direction of limitation to gain an increase in range. The technique is used as often as possible, and is followed by 'repeated

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Fig. 3

'Stasis hand.' Mild traction through use of glove prevents hyperextension of metacarpophalangeal joints. Alkathene slab maintains wrist in extension.

contractions' to consolidate any increase in range. Heat treatment is usually given before these exercises, wax baths being used to reduce pain and muscle spasm.

'Stasis hand' and 'Stasis foot': When oedema is present over the dorsum of the hand and fingers, gentle traction may be given through a glove to prevent hyperextension of the metacarpophalangeal joints and contracture of the collateral ligaments (Fig. 3). A plaster of Paris or alkathene anterior slab extending to the mid-palm may be used to prevent flexion contracture of the wrist. If the intrinsics are in spasm and show a tendency to flex at the metacarpophalangeal joint level, the plaster of Paris anterior slab may be extended to just below the level of the proximal interphalangeal joint so that, with the metacarpophalangeal joints held in extension, traction may be applied gently through a glove to flex the proximal interphalangeal joint and to stretch the intrinsics. The glove may be removed twice daily for wax baths and exercises, given with the hand held in elevation. These exercises must be directed at maintaining full range of movements in all the small joints of the fingers, particularly the metacarpophalangeal joints. When there is oedema in the region of the thumb web contracture of the soft tissues occurs in this area; this contracture may interfere with abduction and rotation movements needed for normal function of the thumb. Active exercises to maintain full range of movement in the thumb are therefore encouraged. When subcutaneous nodules or panniculitis is present over the dorsum of the hand and there is a tendency for adhesions to form with the underlying extensors, massage is given to the scarred area with oil, using circular, transverse and longitudinal frictions to mobilise the scarred structures. Ultrasound therapy may also be employed for this purpose, the dose being 0.5 to 1 watt per square centimetre for 5 to 6 minutes daily until the area is mobilised.

The 'stasis foot' is maintained in a plaster of Paris or alkathene back slab and elevated to prevent tendo Achillis contracture and to reduce oedema. The back slab also prevents the great toe and the other toes from developing flexion contractures. Wax baths are used for the feet, followed by active exercises for the toes and ankles.

Neuritis: Where there is evidence of a painful neuritis either in the upper or lower extremities a well-padded plaster is applied to rest the nerve. The plaster is maintained over a period of 5 to 6 weeks, during which time isometric exercises are encouraged within the plaster to prevent muscle atrophy. At the end of this period, the plaster may be removed and reeducation started to restore muscle strength. Lively splints are used when indicated by muscle weakness.

Ulcerations: Particular attention should be paid to the ulcerations occurring from the necrotising forms of ENL, over either the extensor or the flexor surface of the fingers. When these ulcerations occur over the dorsum of a finger, they tend to damage the delicate dorsal apparatus. When occurring near the flexor crease of a finger, they heal with scar tissue which tends to contract. The hand should be carefully immobilised in a functional position until the ulcers are well healed. The scarred areas may then be gently massaged with oil and the fingers actively exercised to restore function.

Osteoporosis: Osteoporosis due to disuse becomes completely reversible when active movements are instituted over a period of time or when the patient returns to work. Osteoporosis due to diffuse lepromatous involvement of the bones takes many months, or years, to heal. These bones are vulnerable to damage, and the patient must be warned not to use his hands for strenuous activities and hard manual labour.

### CONCLUSION

If competent physiotherapeutic care is given both in the acute phase and during the phase of recovery deformity is prevented and function restored. The accumulated effect of repeated episodes of reaction is tissue damage and diminished function, especially in the small joints of the fingers, and peripheral nerve damage. Complete correction of residual deformity should be attempted during quiescent periods in those patients who suffer from recurrent bouts of reaction.

# SUMMARY

The complications arising in 42 consecutive patients with lepromatous leprosy during reactive phases of the disease are reviewed. Damage to skin, nerve, muscle, bone and joints is recorded, and an attempt made to study the aetiology of deformity relative to these complications. Physiotherapeutic care of the patient during the acute phase and the phase of recovery is described. Specific physiotherapeutic management of stiff joints, 'stasis hand' and 'stasis foot', ulcerations, neuritis and osteoporosis have also been detailed.

<sup>•</sup> Although imperceptibly progressive damage and reduced function in muscles and nerves may occur with repeated episodes of reaction, careful comprehensive physiotherapeutic care will minimise the functional loss.

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