# Stasis Hand. The Shoulder-Hand-Finger Syndrome in the Reactive Phases of Leprosy

## Preliminary Study[1, 2]

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Physical therapy in the management of the hand in the reactive phases of leprosy is one of the most difficult problems confronting the physical therapist who works in leprosy. Without proper management the end result is often the "frozen hand" (here called "stasis hand") that defies surgical correction and the ingenuity of the physical therapist. During the past 18 months a study was conducted in this institution on the hand in the reactive phases of leprosy.

The intent of this paper is to analyze the anatomic and physiologic factors involved in the development of the "frozen hand," and to point out that many of the features of this condition are similar to the features of the shoulder-hand-finger syndrome, which has been well studied in nonleprosy cases. It suggests that much of the pathology of the hand in leprosy reaction may be due to this syndrome, and it explains why hands affected by the reactive phases of leprosy do well if the physiotherapy is directed along the lines required for the shoulder-hand-finger syndrome.

### MATERIAL

This is a study of 48 upper extremities of 25 patients who developed the shoulder-hand-finger syndrome during the reactive phases of leprosy. In two patients the components of the syndrome were noticed in one extremity only. In three patients the hand-finger syndrome had developed while the patients were ill at home; 22 patients were admitted for investigation and control while in the reactive phase.

### REACTIVE PHASES OF LEPROSY

It seems necessary at the outset to describe briefly the reactive phases of leprosy. From time to time, in all the main types of leprosy except the indeterminate group, the disease passes more or less suddenly through a period called "reactive phase." The concept generally accepted is that of a tissue response resulting from the liberation of bacilli or their products into the tissues(4).

Patients in the reactive phases of leprosy are frequently ill with fever and general malaise. The nerves may become swollen and tender, the eyes inflamed, and the skin lesions erythematous and infiltrated. Painful red spots, characteristic of erythema nodosum leprosum (ENL), may show on the face, trunk and limbs (4), and in some cases ulcerate. Lymphadenitis and edema of the extremmities are common features(7, 11) (Table 1).

### SHOULDER-HAND-FINGER SYNDROME

The shoulder-hand-finger syndrome has been given various names, some based on particular features, others on what is assumed to be its origin or end result (1, 6, 8, 15). Many conditions may cause the syndrome, and different names prevail in different fields of medicine. Some authors, among them Adams-Ray (1), Bunnell (3), De Palma (6) and Furlong (8), have described its various components, while others, like Moberg (13, 14) and Vaernet (16), have presented it as a distinct entity.

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TABLE 1. *Complications observed in 25 patients during the reactive phase of leprosy.*

| Complications | No. cases | Per cent |
|---|---|---|
| Fever | 25 | 100 |
| Polyarthralgia | 17 | 68 |
| Polyneuritis | 13 | 52 |
| Edema | 25 | 100 |
| ENL | 21 | 84 |
| Lymphadenitis | 23 | 92 |

Moberg, who has described it in detail, states that it has two main components: the shoulder component, and the hand-finger component. The hand component does not always follow after immobility or contracture of the shoulder, nor the shoulder component after hand lesions. Moberg maintains, however, that it is often possible to find a trace of the shoulder component even in the early stages of the hand-finger component, and vice versa, although the first component may not still trouble the patient. The syndrome is obviously connected with inability to lift the arm fully and clench the fist completely ([13]).

In the reactive phases of leprosy the fully developed syndrome is seldom seen, although the early stages of the different components are of common occurrence ([2, 15]). In this series, only one patient was seen to develop the complete syndrome in both upper extremities.

## ANATOMIC AND PHYSIOLOGIC COMPONENTS

The anatomic and physiologic components that constitute the syndrome may provide a starting point for a serious chain reaction. The principal factors to be considered are:

1. Circulation of the hand and the arm.
2. Immobility of the shoulder.
3. Flexed position of the wrist.
4. Extended position of the metacarpophalangeal joints and its effect on the collateral ligaments.

**Circulation of the hand and the arm.** The tendency to edema in the hand is connected with the circulatory system in the arm ([3]). It is well known that while arterial pressure provides sufficient flow to the arm, a pumping mechanism is needed for the back flow of both blood and lymph. This is provided by the compression of a vessel during contraction of a muscle mass in a fascial compartment, forcing the fluid in a centripetal direction with the aid of valves in the vessel wall. This back flow can be assisted also by gravity, as in elevation of the arm.

The two main pumping mechanisms of the upper extremity are situated in the axilla and over the dorsum of the hand ([3]). In the region of the axilla the veins and lymphatics are enclosed in a compartment of muscles and fasciae so that movement of the shoulder causes constriction and dilatation of the vessels within the various compartments, while complete elevation of the hand will suffice to empty the dorsal veins of the hand. The dorsal veins may also be emptied by clenching the fist strongly. Subsequently, extension will allow refilling of the vessels by compression of soft tissues in the volar space under the palmar fascia. Compression of the large group of lymph glands in the axilla is also to a large extent dependent on shoulder movement.

The pumping mechanisms of the axilla and of the hand play a significant role in the circulation of the upper extremity ([14]). If the normal arm of a young person is kept completely immobile alongside the body, edema develops in 6 or 7 hours ([13]). Immobility of the shoulder would therefore mean impairment of outflow from the arm, resulting in the production of edema. The edema is most marked under the loose tissues on the dorsum of the hand and in the fingers (Table 5). This in turn impairs the mobility of the skin over the metacarpals, restricting finger flexion and putting out of action one of the main pumping systems of the hand. When this happens, the outflow from the digits and the volar space is impeded and gives rise to the production of more edema.

A vicious cycle is set up: interference in the pumping mechanism of the axilla produces edema in the hand; edema of the hand impairs the pumping mechanism of the hand; and edema is increased. With

increased edema the grasping power of the hand is reduced and this results in further limitation of shoulder movement.

Fever, joint pains, peripheral neuritis, and painful spots of ENL, which are frequently scattered over the limb, may produce temporary loss of function of the limb. Lymphatic return will also be impeded in most cases by lymphadenitis. In this study it was observed that all 25 patients tended to hold their limbs immobile during the reactive phase. Lymphadenitis was present in 46 out of a total of 48 limbs.

**Immobility of the shoulder.** Generally this component of the syndrome is caused by immobilizing the shoulder for such conditions as fracture of the neck of the humerus, ruptures of tendons or ligaments, nerve injury with paralysis, and arthritis. Even keeping the arm in a sling is sufficient to impair shoulder mobility. The early signs are slight limitation in rotation and elevation. Later it may lead to contracture of the shoulder joint with pain and limitation of movement.

In the cases under review 44 shoulders were held in an adducted position, out of a total of 48, during the reactive phases of leprosy (Table 2). Two of these developed contractures of the shoulder joint (Table 3).

**Flexed position of the wrist.** A classic series of events may follow injury and pain in the hand. As described long ago by Hilton in his "Rest and Pain" (9), the joints assume a position of ease. There is an early psychic release of the extensors, protective in nature, which permits the wrist to drop. The flexed position of the wrist causes impairment of the long digital flexors and thereby reduces the effectiveness of the dorsal pumping mechanism of the hand. When the wrist is flexed over an extended period it tends to contract. Wrist contractures may lead in time to contractures of the digital flexors. The process of contracture of the wrist and digital flexors may be accelerated by the presence of edema in the forearm (Table 5).

This phenomenon of wrist flexion was observed in 30 limbs, five of which developed contractures of the wrist joint (Tables 2 and 3).

**Extended position of the metacarpophalangeal joints and its effect on the collateral ligaments.** While the wrist is held in flexion the dorsal skin tightens somewhat and tends to extend the metacarpophalangeal joints of the fingers. When the dorsal skin is tented with edema, extension of the metacarpophalangeal joints is marked and more stress is laid on the metacarpal arch, aiding its reversal. Other factors, such as contracture of the long extensor muscles following edema of the forearm (Table 5), or an intrinsic paralysis (Table 4), may also contribute to the reversal of the metacarpal arch. Metacarpophalangeal joint extension was observed in 20 cases (Table 2), and a complete reversal was noted in 10 cases (Table 6).

The collateral ligaments of the metacarpophalangeal and the proximal interphalangeal joints are powerful structures. Their chief characteristic is that they run an oblique course so that they are under maximum tension in the flexed position and entirely relaxed in the extended position. If they are maintained for too long in the extended position they tend to shorten. An intrinsic paralysis occurring during the reactive phase of leprosy increases the chances for contracture of the collateral ligaments.

In this study intrinsic paresis or paralysis was noted in 16 limbs (Table 4). Contractures of the metacarpophalangeal joints were recorded in 17 hands, and contractures of the proximal interphalangeal joints in 15 hands.

## EDEMA

The entire sequence of events already described, acting separately or together, leads to the production of edema, which has been a constant feature of this syndrome. In the reactive phase of leprosy the edema may be distributed over the arm, the forearm, the dorsum of the hands, and the digits (Table 5). While the hand remains soaked in serofibrinous exudate, fibrin is deposited in joint capsules, ligaments, tendons, and muscles. All the involved tissues become scarred and contracted. The synovial membrane, capsules of joints, ligaments, and tendons become

TABLE 2. *Posture of 48 limbs in the reactive phase.*

| Adducted shoulder | | Flexed wrist | | Extended M.Ps[a] | | Flexed P.I.Ps[b] | | Adducted thumb | |
|---|---|---|---|---|---|---|---|---|---|
| No. | % | No. | % | No. | % | No. | % | No. | % |
| 44 | 92 | 30 | 63 | 20 | 42 | 26 | 54 | 16 | 33 |

TABLE 3. *Contractures developing from posture of joints in 48 limbs.*

| Shoulder | | Wrist | | M.Ps[a] | | P.I.Ps[b] | | Thumb web | |
|---|---|---|---|---|---|---|---|---|---|
| No. | % | No. | % | No. | % | No. | % | No. | % |
| 2 | 4 | 5 | 10 | 17 | 35 | 15 | 31 | 12 | 25 |

[a] M.Ps = Metacarpophalangeal.
[b] P.I.Ps = Proximal interphalangeal.

TABLE 4. *Nerve involvement in 48 limbs in the reactive phase.*

| Paresis | | Paralysis | |
|---|---|---|---|
| No. | % | No. | % |
| 6 | 12 | 10 | 20 |

TABLE 5. *Distribution of edema in 48 limbs during reactive phase.*

| Arm | | Forearm | | Dorsum of hand | | Fingers | | Thumb | |
|---|---|---|---|---|---|---|---|---|---|
| No. | % | No. | % | No. | % | No. | % | No. | % |
| 6 | 13 | 14 | 29 | 37 | 77 | 38 | 79 | 33 | 70 |

TABLE 6. *Deformities in the final stage.*

| Atrophic skin | | Intrinsic minus position | | Intrinsic plus position | | Reversal of mc[a] arch | | Complete hand finger syndrome | | Complete shoulder-hand-finger syndrome | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| No. | % | No. | % | No. | % | No. | % | No. | % | No. | % |
| 25 | 69 | 14 | 30 | 3 | 6 | 10 | 21 | 4 | 8 | 2 | 4 |

[a] mc = metacarpal

FIG. 1. The intrinsic minus position of the hand with the metacarpophalangeal joints in hyperextension and the proximal interphalangeal joints in flexion. Note the atrophic skin over the dorsum of the hand and fingers.

FIG. 2. The intrinsic plus position of the hand with slight flexion of metacarpophalangeal joints and hyperextension of the proximal interphalangeal joints. Note persistent edema over the dorsum of hand.

plastered together with organized adhesions.

The greater the amount of edema fluid and the longer it persists, the more extensive will be the amount of scarring. In leprosy repeated bouts of exacerbation of the disease with edema tend to produce increased deformity of the hands ([15]). The vessels become embedded in scar tissue, and nutrition to the various parts is impaired. The nerves may sustain partial loss of function, and range and power of contraction of the intrinsic muscles may be greatly reduced. Contractures occur in the fingers and in the thumb web. Cords of subcutaneous induration caused by edema are sometimes observed over the dorsum of the hand. In some hands the metacarpophalangeal joints stiffen in extension and the proximal interphalangeal joints in flexion (intrinsic minus position) (Fig. 1). In others the metacarpophalangeal joints are held in flexion while the proximal interphalangeal joints stiffen in extension, with a corresponding flexion of the terminal interphalangeal joints (intrinsic plus position) (Fig. 2). The deformities vary according to the structures that are scarred and contracted. The skin becomes atrophic with the digits and hand slightly swollen (Table 6). This is the "stasis band" of leprosy, and closely resembles the changes seen in scleroderma or acrosclerosis.

## RATIONALE OF PHYSICAL THERAPY

From a study of the syndrome as it occurs in leprosy, three facts seem to emerge:

1. It has become possible to understand how the different components are connected, how they are caused, and how they appear at different stages, thus increasing the chances of early effective physical treatment.

2. It is better to prevent the development of the syndrome, especially of the hand-finger component, because of its poor prognosis.

3. Physical treatment should be aimed at factors that aid in preventing and limiting edema.

In the early stages mobilization of the limb at the shoulder, elbow, and wrist is necessary. Active exercises whereby the patient is instructed to lift both arms at once, and to clench and unclench his fist, should prove adequate. Vigorous movements are not attempted until the acute phase has settled down. With very ill patients comfortable elevation of both arms is also indicated. Posture of the wrist and the metacarpophalangeal joints may be maintained by the use of a cotton glove for the hand and gentle traction with elastic bands. The hand may be placed over a padded wire frame to keep the wrist in extension while allowing free movement of the fingers (Fig. 3). It should be pointed out, however, that the results are entirely dependent upon how much the patient cooperates, and time must be spent showing him how to do so efficiently and encouraging him.

For the moderately advanced cases, heat to increase circulation, followed by exercise in elevation, helps to reduce the edema and mobilize the small joints of the hand. Wax baths appear to be the ideal form of heat treatment for these hands, and faradism under pressure may also be used effectively in the reduction of edema. In these cases active movements must be encouraged. Posture of the metacarpophalangeal joints should always be one of flexion and must be constantly maintained by the use of a glove and gentle traction. The patient may be taught to remove the traction and practice flexion and extension of the fingers several times a day.

In the advanced stage heat treatment followed by deep frictions and finger kneading may help to mobilize the skin and subcutaneous tissue. Axial tractions around a wire frame to obtain metacarpophalangeal joint flexion and proximal interphalangeal joint extension may also be employed. Contracted thumb webs may be stretched by serial plasters.

Physical treatment in the final stage is a long drawn out process, but some improvement in function can be obtained in almost all cases with patient, persistent effort.

## SUMMARY

The relationship between posture and

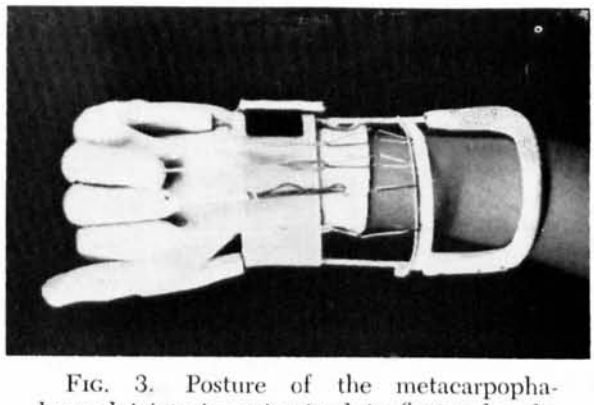

FIG. 3. Posture of the metacarpophalangeal joints is maintained in flexion by the use of a glove and gentle elastic traction. A padded wire frame holds the wrist in extension.

the development of the "stasis-hand" (shoulder-hand-finger syndrome) has been studied in 48 upper extremities of 25 patients in the reactive phases of leprosy.

The anatomic and physiologic components considered are: (a) circulation of the hand and the arm, (b) immobility of the shoulder, (c) flexed position of the wrist, and (d) extended position of the metacarpophalangeal joints and its effect on the collateral ligaments.

The rationale of physical therapy is based on the facts that emerge from study of the syndrome as it occurs in the reactive phases of leprosy: (a) early detection of the syndrome by understanding how the different components are connected, how they are caused, and how they appear at different stages; (b) prevention of the development of the syndrome, especially of the "stasis-hand" because of its poor prognosis; and (c) institution of those methods of physical therapy that aid in preventing and limiting edema.


## RESUMEN

La relación entre posición y el desarrollo de "stasis-hand" (syndrome hombro-manodedo) ha sido estudiado en 48 extremidades superiores de 25 pacientes en la fase reaccional de la lepra.

Los componentes anatómicos y fisiológicos considerados son: (a) circulación de la mano y del brazo, (b) inmovilidad del hombro, (c) posición de flexión de la muñeca, y (d) posición de extensión de las articulaciones metacarpo falángicas y sus efectos en los ligamentos colaterales.

La razón de la terapia física se basa en los hechos que derivan del estudio del syndrome como ocurre en la fase reactiva de la lepra: (a) descubrimiento temprano del syndrome mediante el entendimiento como los diferentes componentes del syndrome se relacionan, cual es su causa, y como ellos aparecen en diferentes etapas; (b) prevención del desarrollo del syndrome, especialmente del syndrome de "stasis-hand" a causa de su mal pronóstico; y (c) institución de aquellos métodos de tratamientos físicos que ayudan a prevenir y a limitar el edema.

## RÉSUMÉ

Chez 25 malades souffrant d'épisodes réactionnels de lèpre, on a étudié, au niveau de 48 extremités supérieures, la relation entre la position et le développement du syndrome épaule-main-doigt (main de stase).

Les composantes anatomiques et physiologiques sont les suivantes: (a) la circulation au niveau de la main et du bras, (b) l'immobilité de l'épaule, (c) la position en flexion du poignet, (d) la position en extension des articulations métacarpophalangiennes et l'effet de cette position sur les ligaments collatéraux.

Les bases rationnelles de la physiothérapie sont basées sur les faits qui se dégagent de l'étude de ce syndrome tel qu'il survient dans les phases réactionnelles de la lèpre: (a) le diagnostic précoce du syndrome, qui nécessite un compréhension de la relation entre les différentes composantes, de leurs causes et du mécanisme de leur apparition aux différents stades; (b) la prévention du développement de ce syndrome, et plus particulièrement de la main de stase, fort important à cause du mauvais pronostic; (c) l'établissement des méthodes de physiothérapie adéquates qui peuvent contribuer à prévenir et à limiter l'oedème.


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